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NEEDED STAR-SURVEYS.

BY RICHARD A. PROCTOR.

(*Continued from p.* 83.)

THE proper way of applying the test by those statistical methods which Struve loved,—but which I reject as utterly inadequate for any but the simpler problems of stellar distribution,—would clearly have been to have counted the stars in the Milky Way (or on a galactic zone of such and such breadth) noting the area of the region thus dealt with, then to have counted the stars in the regions of the heavenly sphere outside the Milky Way (or that galactic zone) noting the area *thus* dealt with, and then to have compared the wealth of stars in these two areas—the galactic and the non-galactic. Supposing the charts or catalogues used for this work to have resulted from a fairly uniform survey of the heavens, or were it even only of the northern hemisphere, with a telescope of small power, the result Struve would have thus obtained would have been satisfactory enough.

This was not what he did. Probably he had not time. The process he actually applied indicated certainly that he was somewhat pressed for time, since it could not have taken him much more than ten minutes. He took a certain catalogue of stars down to the ninth magnitude. In these the stars to a certain distance on either side of the equator were arranged in the order of the twenty-four hours round the celestial sphere (technically in order of their Right ascension) and numbered from first to last. The number of stars in the first hour was thus indicated in the catalogue as the number of the last star within that hour, the number in the second hour was obtained by subtracting the number of the last star in the first hour from the number of the last star in the second hour; and so on for the numbers of stars in the third, fourth, fifth hours, and so on, up to the twenty-fourth. Twenty-three subtractions gave Struve all the statistics he employed. He found that the fifth, sixth, and seventh hours on one side of his zone, and the eleventh, twelfth, and thirteenth on the other, were richer in stars than the rest, in such degree as to show that the Milky Way, which crosses the equatorial zone aslant at those hours is richer than the non-galactic parts of the heavens. But it is hardly necessary to say that the real relative star-wealths of the Milky Way and of parts outside it could not be properly indicated by so rough an inquiry as this. It afforded an independent proof of the general law which Sir W. Herschel had already recognised at the beginning of the present century; but it scarcely added more to our knowledge.

My own inquiry into this particular point involved rather more labour. I proposed at first to use the catalogues and charts of Argelander, in which 324,198 stars (down to magnitude 9-10) are included, taking the numerical distribution over the Milky Way, and then over regions outside of it. But a few tests showed me that while this method would involve almost as much work as a process of actual charting, it would be much less satisfactory. I determined, therefore, after consulting the venerable Sir John Herschel on the subject (this was but a year before his death), to chart every single star of the 324,198 in its proper place, on an equal surface projection of the northern hemisphere,—that is, a projection in which equal surfaces on the heavens were represented by equal areas in the map. I laid down in pencil a series of radial lines a degree apart (360 in all), and ninety-two concentric circles at one-degree distances (gradually diminishing outwards), corresponding to the particular projection which I was employing. Then in the 33,000 spaces thus formed I marked in the stars shown in the corresponding 33,000 spaces of Argelander's forty charts. Thus I had, charted on a uniform scale, all the stars observed by Argelander and his assistants, during seven years, in their survey of the heavens from the north pole to a distance of ninety-two degrees all round, or to two degrees south of the equator.

The work occupied me in all almost exactly four hundred hours.

But the result was, I think, well worth the trouble.

In the first place, I note a peculiarity in the large chart of 324,198 stars, which attracts attention at once, yet is manifestly accidental, or due, rather, to the method in which the original series of 40 charts, and the single chart itself, were formed. The peculiarity is a defect, though of little importance,—yet interesting as illustrating the points which have to be attended to in such work. The circular chart seems to show in places multitudes of concentric streaks produced by the aggregation of stars along certain very narrow zones, concentric with the boundary of the map,—that is to say, having the north pole of the heavens as their centre. As my friend Professor Young pointed out, there cannot conceivably be any real tendency in the stars to form circular zones around the pole as centre, or along declination parallels: yet such a tendency seems manifestly suggested by the appearance of the great chart when closely studied. So far as the broad results sought and obtained are concerned, this peculiarity is of no more weight than the direction of the linear streaks by which in an engraving effects of light and shade are produced. Still until or unless the peculiarity is explained, it detracts something from the confidence with which those broader results are accepted.

Not really existing in the heavens, how does this peculiarity of star-distribution come to appear in the chart? The answer, though not at a first view obvious, is simple enough. The wonder would be if the peculiarity had not shown itself. Argelander and his assistants, in their survey of the northern heavens, swept the skies in circles round the north pole, after the manner of survey with the equatorial telescope, which works in that sort (its main axis being directed polewards). Now herein is at once a possible cause of circular striation in the resulting charts,

from the circumstance that one sweep might be made when the air was exceptionally clear, when moonlight was wanting, and other conditions for showing faint stars favourable (amongst other causes, difference of observing power among the six who took part in the work must be taken into account), while the next sweep might be made under conditions unfavourable for the work. This, however, is only a *possible* cause of circular striation, though in so long a series of observations it must inevitably have occurred at times, and so had *certainly* a share in producing the peculiarity in question. But there was also a sure and certain cause of striation. The field of view of a telescope is a circle, and in "sweeping" the centre of one field runs along a certain arc, while the next field is taken a certain distance south of that arc (or north of it, according to the way the observer works). Say the field is half a degree in diameter, and the change north or south for successive sweeps nearly as great of a degree, so that one field only overlaps by a little the field next north or south of it. Then it is clear that the chance of discerning a faint star near the course along which the centre of the field sweeps is much greater than the chance of discerning a star where the fields overlap; for in one case a whole diameter of the field is available for search, in the other only a short arc. In sweeping, the star will not escape in one case if it be seen at any part of the comparatively long time during which that diameter is passing; but in the other case, if it be not caught while the short arc is passing it will not be caught at all. Thus, it is absolutely certain that fewer stars will escape along or near the tracks of the centres of the sweeping fields than midway or nearly midway, between the tracks of the centres. A concentric circular striation must necessarily result. To this must be added the probability that, however carefully I marked in my ninety-two circles there may have been slight departures from their true positions, whereby some of the zones were made slightly wider or slightly narrower than they should have been. This would make the striation more marked in some places less marked in others than it would otherwise have been, but, on the whole, would help to make it coarser, and therefore more obvious.*

But, thus explained, the circular striation is of no more moment than the linear striation in engravings.

(To be continued.)

* It is interesting to notice how inevitably any peculiarity in the method of distribution in such cases is bound to show itself. I remember being very much struck by an example of this which arose when I was endeavouring to secure perfectly equable chance distribution for comparison with the unequal distribution of stars of various orders, which I regard as so important a feature of the stellar heavens. After trying various methods I thought of the following:—I drew a square 10 inches in the side, and divided it into 10,000 squares by equidistant parallel lines in pencil, 100 each way. Opening then a book of logarithms at random, I brought down a pencil point at random on the tables of figures, taking out the digit nearest the point. When I had obtained four digits in this way—as say 4725, I regarded the two first as showing the number of divisions I was to take along one side of the square, in this case 47, and the other two as showing the number of divisions I was to take along an adjacent side, in this case 25,—where these divisions crossed, that is where the 47th row from the left crossed the 25th from the right, was the square in the middle of which I was to set a point. So I went on until I had marked in many thousands, and indeed tens of thousands of points. For I got others to help me in the work. Here surely was a method of pure chance, bound to result in equable distribution. But no. When the work had gone far enough, I rubbed out the pencil lines, and found a marked tendency to parallelism in certain bands where there were more dots than elsewhere, this parallelism showing itself on the vertical zones corresponding to the numbers 2, 3, . . . 5, 6, ... 8, 9, 10, . . . 12, 13, . . . 15, 16, ... 18, 19, 20, . . . 22, 23, ... 25, 26, ... 28, 29, 30, and so on, and on the horizontal bands corresponding to the same numbers. The light bands corresponded to the vertical and horizontal bands numbered 1, . . . 4, ... 7, ... 11, . . . 14, ... 17, . . &c. The explanation was simple enough. The figures representing 1, 4, 7, cover less space than the others, and by my method of taking out digits there was more chance of taking one of the *fat* figures, 0, 2, 5, 6, 8, and 9, than one of these *lean* figures, 1, 4, and 7.

THE ENTOMOLOGY OF A POND.

By E. A. Butler.

THE MARGINS.

ALL the insects hitherto considered spend more or less of their life either actually in or on the water, and are therefore correctly designated aquatic; but there still remain others, which, though terrestrial during their whole career, must yet receive a passing notice, since they are closely associated with water, which, indeed, seems to be almost as essential to their existence as to that of their truly aquatic brethren. They constitute the very abundant fauna that sports about on the banks and round the margins of our ponds, and consist chiefly of beetles, which belong for the most part to the two sections, Geodephaga, or carnivorous ground-beetles, and Brachelytra, or rove-beetles, the characteristics of the latter of which we considered at some length on a former occasion (see Knowledge, Vol. V., p. 26). Suppose we have a gently-shelving bank, with plenty of loose stones lying about over the partially-consolidated mud of which it is composed; when bright sunshine lights up the scene this spot will swarm with life, little beetles rushing about, hither and hither, as fast as their legs can carry them, and that is sometimes at a truly marvellous pace. But the liveliness of the scene will be apparent only to the close observer; if any one, without gazing at any one spot in particular, merely takes a general view from the usual level of his eyes, he *may* become dimly conscious of a few hazy forms moving about at his feet, but no more than that; and, in all probability, he will see no living being at all, and will think the place utterly barren of life, but let him condescend to stoop, or better, go down on his knees, and fix his eyes on some definite spot for a few moments, and he will soon see first one queer little form, and then another and another, crossing the field of view, till at last, when his eye has become familiarised with the outlook, and he is able to cover a wider area without losing sight of the details, he discovers multitudes of creatures trotting about in all directions, each intent on the absorbing business of its own little life, and he wonders how it was possible for him to have missed seeing them before. If the same spot be visited on a dull day, the population will appear to be much more scanty; many of the inhabitants will have retired under shelter, and must be sought for under the stones, &c. If there be simply muddy banks, or better still, a broad mud flat, only recently left bare by the lowering of the level of the water through evaporation, vast numbers of tiny rove-beetles will be seen running about in all directions, many of them turning up their tails over their backs, as though they would utilise them as umbrellas or sunshades. If, again, there be here and there piles of dead leaves, bits of sticks, or other rubbish, washed up and stranded when the water stood at a higher level, these heaps, on being turned over or shaken above a piece of paper, will often yield abundance of beetles of various kinds, which have been putting up there in temporary lodgings, or perchance have been finding therein excellent board as well as lodging.

Some of these riparian beetles are adorned with most brilliant metallic colours—green, golden, bronze, coppery; and, as they dart swiftly about in the sunshine, like flashes of light, they look marvellously beautiful. One of the handsomest, *Anchomenus marginatus* (Fig. 1), is a fairly

common insect. It is about $\frac{3}{8}$-inch long, of elegant shape, having quite the air of one of the *élite* of coleopterous society, and with rather long and slender legs, indicative of agility and speed. It is a very chameleon in colour, generally greenish or coppery, but the exact hue depending on the direction in which it is looked at, and down the outer edge of its wing-cases runs a narrow, pale yellowish-white marginal band. Though clad in splendid attire, it is

Fig. 1.—Anchomenus marginatus.

Fig. 2.—Elaphrus riparius.

a hard-hearted and merciless being, and many are the small beetles that have cause to rue the day on which it first appears amongst them; in fact, what with this and other predaceous insects, the bank we have imagined is a terrible scene of warfare and carnage; and, though all seems so peaceful to our dull senses, yet could we but improve our auditory powers to microphonic acuteness, we should hear the crunching of hard corselets on every hand, as the smaller and weaker mail-clad forms fall one after the other under the jaws of their more powerful assailants. Several other *Anchomeni* may often be found in similar situations, though few of them can make such pretensions to beauty, except in form.

Anchomenus marginatus is rivalled in elegance by two very peculiar beetles, whose full splendour, however, does not appear till they are viewed with a lens. They are called *Elaphrus riparius* and *cupreus*. The former (Fig. 2) is dull bronze green, and the latter deep purplish brown, and both have on their roughly shagreened wing-cases a number of curious oval depressions, which in the former species are of a lovely violet colour. Their eyes are very prominent, as is often the case with moisture-loving insects, and their legs are extremely slender for such comparatively bulky creatures. They dart about with great agility, ever and anon suddenly stopping, and then as suddenly dashing off again at full speed.

Mud flats and the margins of ponds and streams are excellent localities for the large genus of carnivorous beetles called *Bembidium*. It contains nearly fifty British species, which are amongst the smallest of our terrestrial predaceous beetles. They are elegantly formed, very hard, brightly polished beings, usually dark-coloured, and often having four yellow spots occupying more or less of their wing-cases. One of the commonest of these is *B. quadriguttatum*, a most brilliantly polished, dark greenish-black insect, with four conspicuous yellow spots on its back. The genus may be recognised and distinguished from most others of the Geodephaga by the peculiar structure of their maxillary palpi, the terminal joint of which is very slender and pointed (Fig. 3).

Of the rove-beetles, many very distinct types are represented; the *Steni*, those little pox-marked creatures described in the article referred to above, are here in full force. These quaint little beings, encased in their hard, unyielding armour, and with their long, stiff tail, have a strikingly reptilian aspect, and would certainly serve very well as models for the dragons at pantomimes; and as they go glaring about with their huge, prominent eyes, they must look formidable objects to their tinier brethren in the coleopterous world. Other genera, cylindrical in form, short-legged and broad-headed, excavate little burrows in the mud, from which it is not easy to entice them.

Fig. 3.—Maxillary Palpus of Bembidium.

Fig. 4.—Salda pilosella.

But the Hemiptera also supply their quota to the marginal fauna, especially from one family, the *Saldidæ*, which contains only one British genus, *Salda* (Fig. 4). They are small, oval insects, blackish in ground-colour, with whitish or pale yellowish-white markings. They are some of the most active creatures imaginable, running with great agility, and alternating this mode of progression with short jumps, or rather with what must be regarded as half jump, half flight. Hence they are the most tiresome things to catch; if you try them with the net, they stick so close to the ground that the difficulty is to get them into your trap; if you adopt the stalking method, and go down on hands and knees (no very pleasant task on a mud-flat) and stealthily pursue them, following up each individual as he skips away, and aiming at him with moistened finger every time he settles, you will probably find that he is off on another jump long before your finger can be brought down upon him; and when at last, by a more careful stroke than usual, you have got him safely underneath the pursuing digit, you probably find that the blow has been made too heavily, and that, instead of securing contact between yourself and your insect, you have simply made an oval dent in the mud, at the bottom of which the poor creature lies, half-embedded in the plastic material, as though you were going to take a cast of him, and the chances are that, as soon as you have extricated him, and are about to transfer him to a pill-box, he gives a hop, skip, and jump, and disappears in a trice. So, much hunting yields but few Saldas, and he who desires to cultivate the virtue of patience, cannot do better than try a day's Salda-hunting. The insects are gregarious, and are often very numerous in suitable localities. There is no mistaking them; their family likeness is very strong, and there is no other Hemipterous insect with which they can be confounded. Like the *Elaphri* and *Steni* amongst beetles, they have very prominent eyes. They may be found in all their stages in the same localities during the summer months. Even when young, they possess considerable jumping power, though, of course, less than when fully grown, as they have then no wings.

Vast armies of flies, too, frequent mud flats, especially when the mud is none of the purest, and contains quantities of decaying vegetable or animal matter. The flies themselves swarm either on, or immediately over, the mud, while their larvæ, or maggots, live on the putrescent matter it contains. If quantities of swampy mud, moss, dead leaves, &c., be placed in a box with a glass cover, multitudes of flies will in course of time hatch out, and will, no doubt, greatly puzzle the student who desires to undertake the formidable task of identifying them.

Here we must bring to a close this series of papers on pond insects. The subject is a most extensive one, and nothing more than a brief outline could here be attempted; still, it is hoped that enough has been said to induce some

readers to undertake the systematic study of this particular branch of natural history; it may be confidently recommended as being an attractive study, and affording plenty of scope for deep and careful thought, as well as for painstaking and accurate observations, which are still much needed.

TRICYCLES IN 1885.

By John Browning.

(*Chairman of the London Tricycle Club.*)

THE STANLEY SHOW.

In spite of the defection of a number of the principal makers, this year's Great Tricycle Exhibition must be pronounced a complete success. The arrangements were so good, that each exhibitor's machines were equally well shown. The leading firm among those who stood out were as well represented as if they had exhibited their machines themselves. Never, on any previous occasion, have the machines been seen to equal advantage. I recollect asking a lady friend what she had seen at a microscopic *soirée*. "Oh," she replied, cheerfully, "such a lot of people looking through microscopes!" At several shows, owing to the machines being put in nooks and corners, I have frequently seen a lot of people looking at tricycles without being able to look at them myself. This was not so at the "Wheeleries." It was the subject of constant remark that you had only to walk round the building to see everything in it.

Stanley and Sutton's Safety Bicycle.

Space cannot be spared in Knowledge for even a list of the tricycles and accessories exhibited—284 in number. I shall notice, therefore, only those exhibits which show ingenuity, novelty of design, or excellent workmanship.

First, then, I would specially note Pausey's Pioneer Direct-Steering Tricycle. This machine has two 35-in. driving-wheels, geared up to 54 in., and a 20-in. front-steering wheel, tangent wheels without laced spokes, double-driving arrangement, and band-break. The machine steers like a bicycle, with a cross-steering bar, which can be used at pleasure with either hand or both. The inventor states that the vibration is less than that of machines with large wheels. This is due to the fact that the rider is placed midway between the three wheels. The weight of the machine is stated as 48 lb., and I should suppose this to be about correct, as I found I could lift it very easily well off the ground with my left hand.

This is just such a tricycle as I have been urging the makers to bring out for the last year or two.

The same maker has a good safety bicycle on a similar plan; but I consider the most original and best safety bicycle exhibited is Starley & Sutton's, of which I give an illustration.

From this it will be seen that the hind wheel, which is the driving-wheel, is nearly the same size as the front wheel, and the sitter is midway between them. This machine is safe, is very superior to most safety bicycles, and must have the minimum of vibration for small wheels. It is almost unnecessary to say that the workmanship is all that could be desired.

Starley Bros., of "Salvo" fame, make a very fine display. I would mention particularly their Salvo Tandem, elegant in design and exquisite in workmanship; their two-track Special Salvo; also their youths' tricycle, with 40-inch driving-wheel, a double-driver, with band-break. This machine would carry twelve stone safely. At the price, £12. 10s., it is the cheapest machine I have ever seen.

Rucker's exhibits are nearly all novelties. That which struck me most was a new direct-action steering arrangement for a front-steering tricycle. A pair of bicycle handles in front of the rider are attached by a long rod, at an angle of forty-five degrees, direct to the top of the spindle of the steering-wheel by a Hook's joint. The steering is effected by raising or lowering one of the handles, the position of the rod, which works in a roller, remaining unchanged. The upper end of the rod is supported on a long, flexible, flat spring, which prevents the vibration of the front-wheel from being communicated to the rider.

I shall have this steering arrangement adapted to my two-chain, central-geared Rucker, which is the fastest machine I have; and when I have tried it well, I will report upon it further.

The principal novelty in machines shown by Rucker is a Safety Tandem Bicycle, in which one rider sits in front of the small wheel and one behind it, on an exactly similar plan to the Humber Tandem Tricycle. Both drivers work by means of one chain on a driving-wheel, about 30 in. to 38 in. diameter. The machine should be fast and safe, and it certainly is compact, light, and strong.

Burdess's Sterling "Queen" Front-steering Tricycle.

Adam Burdess exhibited a capital front-steerer, fitted with patent screw arrangement for putting on the break

and for steering. This I should take to be the safest tricycle made, as, when the break is applied, the rider may leave go of both handles when running down a hill without fear of the machine running too fast or changing its course. The engraving shows this machine with Burdess's spring-seat, but it is made also with Harrington's Arab spring and suspension-saddle.

The Invicta Tricycle, with ten-speed arrangement, is so novel that I propose riding it for a time and reporting on its performance, as it is the only multiple-speed arrangement in which the speed can be changed while the machine is being driven up hill.

Of course, Starley & Sutton's Coventry Chair and Despatch Carrier tricycles were shown, but these I have described in previous articles.

Weston's Convertible Tandem is an ingenious and well-made machine.

The leading feature in the Stanley Show this year was safety bicycles. I do not believe these will take with the public to the extent that makers anticipate, but they will have an important effect in bringing about the further reduction in the size of tricycle-wheels which must come. Only this week Mr. Warner Jones, the inventor of the Devon Tricycle and Swing-frame, has, after a most elaborate investigation, published an article in the *Tricyclist*, in which he gives, as his matured opinion, that a man 6 ft. high should ride a machine with 48-in. wheels if he rides directly over the axle, but that the wheels may be 2 in. smaller in circumference for every inch he sits in front of the axle. Mr. Warner Jones says:—"Choose a wheel two-thirds your height"; and elsewhere:—"For every inch forward the wheel can be reduced 2 in. in circumference."

As I am 5 ft. 3 in. high and sit six inches in front of my axle, this would give for my use wheels 38 in. diameter, and this is exactly the size I have had made for my favourite machines, though I have some made with 36 in. wheels, which I like nearly as well.

Mr. Percy Letchford, who is above middle height and medium weight, and is well known as a fast and daring rider, is having a Humber made for him with 36 in. wheels. His opinion of the machine will be awaited with interest.

THE BEGINNING OF LIFE.*

By Richard A. Proctor.

(*Continued from p. 89.*)

I MAY, in passing, correct an error which is repeated in nearly all our text books of astronomy. Indeed I have never seen the correct statement in any work specially devoted to that science. It is constantly stated that while the place of the vernal equinox moves steadily in one direction, meeting the earth (the precession of the equinoxes), the point of nearest approach moves steadily in the opposite direction. But this is not the case. The motion of the perihelion is sometimes in one direction, sometimes in the other. All that can be said about it is that it is oftener progressive than retrograde, and that just now it is in the midst of a steady progressive motion which has lasted for many thousands of years in the past and will last for many thousands of years to come. I quote from my article on astronomy in the "Encyclopædia Britannica" the following table, showing the position of the perihelion, and the amount of the eccentricity of the earth's orbit, at intervals of 10,000 years from about a million years before Christ to the present time. Excerpt from 100,000 B.C. to 250,000 B.C., for which period intervals of 50,000 years are taken:—

Years B.C.	Longitude of Perihelion ° ′	Eccentricity of Earth's Orbit	Eccentricity Max. or Min.
1,100,000	54 12	0·0303	
1,050,000	4 8	0·0326	
1,000,000	248 22	0·0151	Near Minimum
990,000	313 50	0·0224	
980,000	358 2	0·0329	
970,000	32 40	0·0441	
960,000	66 49	0·0491	
950,000	97 51	0·0517	Maximum
940,000	127 42	0·0495	
930,000	156 11	0·0423	
920,000	181 40	0·0305	
910,000	194 15	0·0156	
900,000	135 2	0·0102	Minimum
890,000	127 1	0·0285	
880,000	152 33	0·0456	
870,000	180 23	0·0607	
860,000	209 41	0·0708	
850,000	239 28	0·0747	Maximum
840,000	269 14	0·0698	
830,000	298 28	0·0623	
820,000	326 4	0·0476	
810,000	348 30	0·0296	
800,000	343 49	0·0132	Minimum
790,000	293 19	0·0171	
780,000	303 37	0·0325	
770,000	328 38	0·0455	
760,000	357 12	0·0540	
750,000	27 18	0·0575	Maximum
740,000	58 30	0·0561	
730,000	90 55	0·0507	
720,000	125 14	0·0422	
710,000	177 26	0·0307	
700,000	208 13	0·0220	Minimum
650,000	141 29	0·0226	
600,000	32 34	0·0417	Near Maximum
550,000	251 50	0·0166	Near Minimum
500,000	192 56	0·0388	Near Maximum
450,000	356 52	0·0308	
400,000	290 7	0·0170	Near Minimum
350,000	182 50	0·0195	Near Minimum
300,000	23 29	0·0424	Near Maximum
250,000	59 39	0·0258	Near Minimum
240,000	74 58	0·0374	
230,000	102 49	0·0477	
220,000	124 33	0·0497	
210,000	144 55	0·0575	Maximum
200,000	168 18	0·0569	
190,000	190 4	0·0532	
180,000	209 22	0·0476	
170,000	228 7	0·0437	
160,000	236 38	0·0364	
150,000	242 56	0·0332	Minimum
140,000	246 29	0·0346	
130,000	259 34	0·0384	
120,000	274 47	0·0431	
110,000	293 48	0·0460	
100,000	316 18	0·0473	Maximum
90,000	340 2	0·0452	
80,000	4 13	0·0398	
70,000	27 22	0·0316	
60,000	48 8	0·0218	
50,000	50 3	0·0131	
40,000	28 36	0·0109	Minimum
30,000	5 50	0·0151	
20,000	44 0	0·0188	
10,000	78 28	0·0187	
0	99 30	0·0168	Near Minimum
1850	100 22	0·0168	

* From the *New York Tribune*, but corrected, extended, and illustrated for Knowledge.

To these add Croll's special calculation for the maximum eccentricity between 851,000 B.C. and 849,000 B.C.

Years B.C.	Eccentricity.
851,000	0·07454
850,000	0·074664
849,500	0·07466
849,000	0·07456

The above table is the result of mathematical computations not open to doubt or question. Any one who examines it will find a remarkable discrepancy between the actual movements of the perihelion and those in the books. These last resulted from a misapprehension of certain results presented by Lagrange and Laplace (independently), indicating a certain progressive movement of the perihelion, which can be employed in all formula extending over the range of time covered by the history of astronomy. Used as they have been, as if they applied to hundreds of thousands or millions of years, they lead to entirely erroneous conclusions.

In passing, also, I may note another common error. Many imagine that the path of the earth is obviously elliptic as well as obviously eccentric, and suppose that it is only the carelessness of astronomical draughtsmen which has caused the earth's path to be always represented as circular. But, as a matter of fact, while the eccentricity is obvious enough on the scale of the usual astronomical diagrams, the ellipticity is too small to show. Even at the time, 850,000 years ago, when the earth's orbit had the greatest eccentricity it has had for the last two millions of years, and very nearly the greatest it can have, the shape of the path was appreciably circular. Putting the mean distance at 13, and the eccentricity (regarded here as a distance) at 1, the departure from the circular form (that is the greatest distance by which the earth's elliptic path fell within the inclosing circle) would be represented by no more than the difference between the square root of 169 (*i.e.*, 13) and the square root of 168 (about 12·96). The numbers 325 and 324 represent the actual proportion between the greatest and shortest axes of the earth's orbit. So that if a circle is drawn with a radius of $3\frac{1}{4}$ in. it nowhere departs more than the 100th part of an inch from the ellipse which would represent with perfect accuracy the orbit of the earth 850,000 years ago, when it was so much more eccentric than it is now. (See figure at page 89, No. 170.)

"Tau Sigma's" theory was associated with somewhat daring ideas as to southern glaciers far vaster than any now existing, and he advanced a new interpretation of the glacial epoch. Lyell's interpretation, based on Croll's calculations, seems quite sufficient to meet all the requirements of the case. But there can be no doubt that the great Antarctic Ocean region is a terrestrial feature well worth careful consideration. If Adhemar's theory, that the northern and southern hemispheres alternate as the chief oceanic regions, had not been accompanied with so much that is unsound, it probably would have been regarded as well worthy of consideration in this connection. There can be no doubt whatever, it seems to me, that the present arrangement is the result of a disturbance which has caused the centre of gravity of the earth's solid mass—or, to be more precise, of that portion of her mass which is bounded by a solid surface—to lie measurably south of the centre of figure.

It is certain that the oceanic surface in the southern hemisphere passes outside the mean surface which the ocean would have if the attractions of the solid globe were more uniformly directed towards (not precisely to) the centre of figure. The sufficient and convincing proof of this is found in the forms of terrestrial promontories, which show that the general surface of the solid crust is not concentric with the surface of the watery envelope. But there is another proof scarcely less convincing which I pointed out seventeen years since—I mean the low barometer of the southern hemisphere. If the sea level rises above its natural mean level in the southern hemisphere the sea surface there would present the constant characteristic of high levels—a low barometer. Now this is precisely what has long been recognised, and had long been regarded as mysterious, though Maury supposed he had found the interpretation. The seas are drawn southward because the earth's centre of gravity is south of the centre of figure. The water thus drawn southward stands in effect as a raised surface above the mean level. The air is also drawn southward; but the centre of gravity for the air is the centre of gravity of the entire mass formed by the solid earth and the waters of the sea. The mean density of the solid earth being nearly six times that of water, it follows necessarily that the centre towards which the air is drawn, though south of the centre of figure of the solid earth, is north of the centre of figure of that incomplete sphere of whose surface the surface of the ocean is part. Hence, estimated for the sea level, atmospheric pressure is higher in the northern than in the southern hemisphere. Whether with a change in the position of the perihelion the water will be drawn northward, and these relations reversed, remains to be seen—a few thousands of years hence. Let us be patient.

THE WORKSHOP AT HOME.

By a Working Man.

A VERY handy, in fact almost indispensable, thing in every house is a step-ladder, or, as it is nearly always called, "a pair of steps." After the rather more complicated work which we have lately been about, the reader will find it a comparatively easy job to make one. Fig. 37

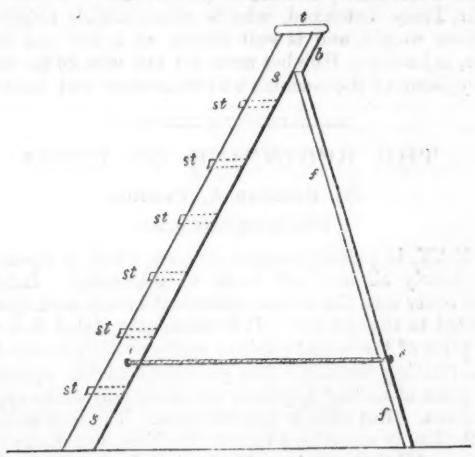

Fig. 37.

gives a side-view of our steps when completed. For the sides, *s*, *s*, the steps, *st*, *st*, and the top, *t*, we shall use deal 1 inch thick in the rough; this will plane up to the proper size. We will make the sides 5 feet 6 inches long, a very handy size, and they shall be 4 inches wide. This will enable us to get two out of a 9-inch plank. The steps, *st*, *st*, are also cut out of 1-inch stuff (I mean 1-inch before it is planed up), and are 5 inches wide, so as to project an inch in front of the sides. Counting the top, *t*, there will be seven steps 9 inches apart. They are let into the sides by grooves,

just as our bookshelves were (Figs. 29 and 30, Vol. VI. pp. 479 and 480); ⅜ in. gives a secure hold, and they may further be glued and screwed (or nailed). As for the length of the steps, we may make the one next the ground 16 in. long, inside measurement, and the sixth one counting from the bottom 1 ft. long, inside measure. This spreads out the base of the steps, and makes them stand more firmly and securely on the ground. In the front, I may mention, the projecting part of the step extends across the whole width, as shown in Fig. 38, A, the plan of the step itself being shown at B. Perhaps I ought to have said before this (what, though, the figures will have made quite clear) that the top and bottom of the sides *s s* must be cut on a bevel to the angle at which the steps will stand when in use. For the top, *t*, we shall want a piece of inch deal 6 in. wide and 14 in. long. A little attention will show that this will overhang the top of the completed steps 1 in. every way. To make a neat job the

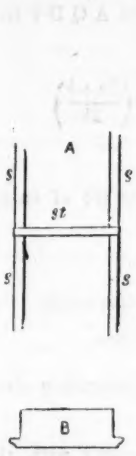

Fig. 38.

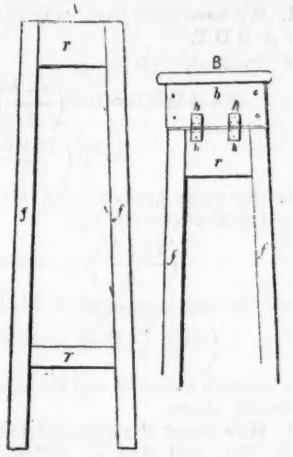

Fig. 39.

sides should be morticed into this, though they may, if preferred, be secured in grooves in it by glue and screws. This being accomplished, we fasten very firmly, by screwing, a piece of inch board, 14 in. by 6 in. wide (*b* in Figs. 37 and 39), flush against the back of the sides and close up against the top *t*. We must evidently bevel the top edges of this to make it fit close against *t*. I have insisted on the firm fixing of this board, *b*, because it is to it that we are about to attach the frame which supports the steps, and which we are immediately going to make. Fig. 39, A, shows the frame completed. It tapers in precisely the same way as the front of the steps—*i.e.*, it measures 14 in. in outside width at the top and 18 in. at the bottom. The rails, *r r*, are morticed into the styles, *f f*, in the usual way. The top rail, *r*, is 6 in. deep; the bottom one, 2½ in. deep—this being the width of the styles too. Note particularly the slight slope which must be given to the sides of these rails, to make them fit true against the slightly diverging styles. The bottom rail may be 1 ft. from the ground. The frame should be attached to the steps by a pair of 1½-in. "butts" (*h h*, B, Fig. 39), screwed, as shown, into the backboard, *b*, and the top rail, *r*. Finally, holes must be bored at *c* and *c'*, in the sides and in the styles of the frame, and pieces of sash-cord passed through them and securely knotted at each end. The length of these cords must be such that they shall be strained quite tight when the base of the steps stands flat on the floor.

And now for a more simple job still. Steps are almost always used indoors. For out-door work a ladder is handy, and I will conclude this paper with directions for making one. First we want a clean, straight fir-pole 18 ft. long, and 22 oak "staves," or "rounds" as they are called at the timber-yards, where they cost a penny each. The pole must be marked off in 9-in. lengths, beginning 9 in. from its thicker end, and bored right through at each mark with a ¾-in. auger. Be sure and bore all these holes truly square to the length of the pole. Then, with a sharp saw, the pole is sawn exactly in a half from end to end, on a line midway between the holes on each side of it. We shall now have the two sides of the ladder flat on the inside and rounded on the exterior. Into the holes in the flat side we drive our staves, which we may first trim up neatly with a spokeshave; and observe to make those at the bottom of the ladder longer than those at the top, so as to spread out the foot of our ladder and give it a firm base. In the one we are making, the bottom round may be 14 in. long, and the top one 9 in. in length, both inside measure, which will give a very good taper. When the rounds are all driven home the ends are sawn off outside of the sides, chisel cuts made, and taper wedges of oak or other hard wood dipped in very thin hot glue and driven hard home in the cuts. Then our ladder is finished.

CHATS ON GEOMETRICAL MEASUREMENT.

By Richard A. Proctor.

(*Continued from p.* 85.)

A. I see that in dealing with curved areas you use varied ways of dividing up the surfaces you wish to determine.

M. Yes; that is the great pleasure of the work—so many ways of attacking problems are open to you.

A. Will you give me some examples which seem to you worth noting.

M. Here is one, taken from my book on the Cycloidal Curves:—

A P D (Fig. 1) is a half cycloid; A *p* B half the generating circle; A B D T the enclosing rectangle (as usual, *i.e.* A T, D T tangents). Draw L *p* P M, *l q* Q *m*, parallel to and equidistant from A T and B D. Then *p* P = arc A *p*; *q* Q = arc A *q* = arc B *p*.

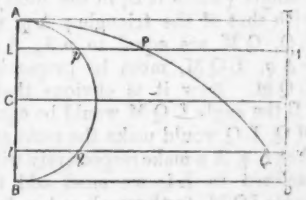

Fig. 1.

∴ *p*P + *q* Q = arc A *p* + arc B *p* = ½ circ. A *p* B = L M or *l m*.

Hence if we regard P *p*, *q* Q, L M, *l m* as elementary rectangular areas, and suppose our parallels to begin from coincidence with A T and B D, moving at equal rates till they coalesce on C *c*, we see that the sum of the areas swept over by the advancing parts *p* P and *q* Q will always be equal to either of the equal areas swept out by L M and *l m*. Hence

area A *p* P + area B *q* Q D = rect A M or rect B *m*,

and area A *p* B D P = rect A *c* or B *c*

= A T. A C = A C. arc A *p* B = generating circle.

Hence area between cycloid and base = thrice the generating circle, as before.

A. That is very simple. You usually take rectangular elements, I notice.

M. They are usually convenient; but in truth you can use any form you please, so only that you assure yourself that each rectilinear element differs eventually from the corresponding curvilinear element, by an area which eventually bears an evanescent ratio to either.

A. Give me an example where some other elements than rectangles are employed. You have already used triangles, but I should be glad of another example.

M. Let us for a change deal with the epicycloid :—

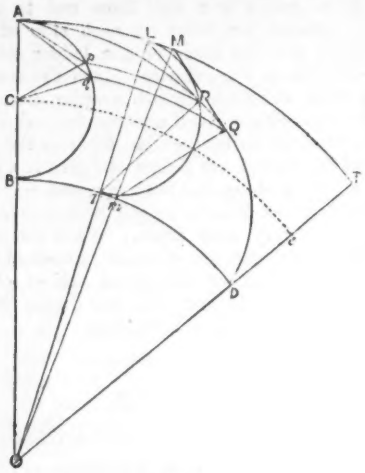

Fig. 2.

Let A (Fig. 2) be the vertex of the epicycloid A P D, A p B the generating circle (radius a); B D the circular base (radius b); A T the enclosing circle (radius $b+2a$); O D T radial.

Through two neighbouring points P, Q, describe arcs P p, Q q about O. Join A p, A q, and draw tangents P L, Q M to the epicycloid. Then we know that if O l L, O m M be drawn cutting B D in l and m, l P and m Q are square to P L, Q M respectively. Thus regarding L Q M as a triangle (which it is, in the limit) and comparing its area with that of the triangle p A q, we see that since the sides L Q, Q M are equal to p A, A q in the limit, the areas p A q, L Q M, must be proportional to the angles p A q, L Q M. Now it is obvious that if m M were parallel to l L the angle L Q M would be equal to the angle p A q (for M Q, L Q would make the same angles with these parallels that A q, A p make respectively with A B). But since m M is inclined to L l, we must add this inclination; viz. the angle l O M, to the angle p A q, to get the angle L Q M.

A. How are we to do this?

M. From the way in which the generating circle rolls in marking out the arc P Q, we know of course that $l m$ is equal to $p q$. Hence, joining C p, C q, we have

angle l O m : p C q :: C p : O l :: a : b

$\therefore$ angle l O m : p A q :: $2a$: b (for angle p C q = $2p$ A q)

and angle L Q M ($=l$ O $m+p$ A q) : p A Q :: $2a+b$: b

wherefore area L Q M : area p A q :: $2a+b$: b.

This being true of all such elements of the respective areas A Q D T and A p q B, it follows that

area A Q D T : semicircle A p q B :: $2a+b$: b

or $$\text{area A Q D T} = \frac{2a+b}{2b} \cdot \text{generating circle.}$$

A. What is the area of A Q D B?

M. That is easily determined. We know the area A B D T.

A. I do not.

M. Pardon me; I thought you did.

A. Well, I suppose the area is easily obtained. Area O B D is equal to $\frac{1}{2}$ the rectangle under O B and the semi-circumference of O B D $= \frac{\pi a b}{2}$ Then

$$\text{area O A T} = \text{area O B D} \cdot \left(\frac{2a+b}{b^2}\right)^2 = \frac{\pi a}{2}\left(\frac{4a^2+4ab}{b}\right) + \frac{\pi a b}{2}$$

wherefore $$\text{area A B D T} = \text{O A T} - \text{O B D} = 2\pi a^2\left(\frac{a+b}{b}\right)$$

M. That is right; but there is a better way of obtaining this result. Imagine A B carried round to D T. Its centre C describes the arc C c, and by a useful property, easily established, the area equals rectangle under arc C c and diameter A B

or area A B D T $= \pi a \cdot \frac{a+b}{b} \cdot 2a = 2\pi a^2\left(\frac{a+b}{b}\right)$ as before.

A. We have now, then, only to take area A Q D T from area A B D T.

M. Precisely; giving us

$$\text{area AQDB} = 2\pi a^2\left(\frac{a+b}{b}\right) - \pi a^2\left(\frac{2a+b}{2b}\right) = \frac{\pi a^2}{2}\left(\frac{2a+3b}{b}\right)$$

Thus the whole area enclosed between one arc of an epicycloid and its circular base

$$\left(\frac{2a+3b}{b}\right) \text{ generating circle.}$$

When the base is straight, or b is infinite, this result

$$\left(\text{since } \frac{2a}{b} \text{ then vanishes}\right) \text{ becomes,}$$

area between a cycloid and its base = 3 . generating circle, as already shown.

A. How about the hypocycloid?

M. You will find no difficulty in dealing with that curve by the same method. It will be a useful exercise. You will obtain the following results,—

Area between epicycloid and base = $\left(3 + \frac{2a}{b}\right)$ generating circle.

Area between cycloid and base = 3 times generating circle.

Area between hypocycloid and base = $\left(3 - \frac{2a}{b}\right)$ generating circle.

A. So that if you have three generating circles of radius a, one rolling outside the second rolling inside a circle of radius b, while the third rolls along a straight line, then

Epicycloidal area + hypocycloidal area = 2 cycloidal area.

M. Yes; with many other relations of a similar kind noted among the problems to my "Geometry of Cycloids."

The whole of the new rolling stock of the Mersey Railway and Tunnel Company is, says the *Engineer*, to be fitted by the Pintsch's Patent Lighting Company with the Pintsch gas-light. Two lights will be fitted in each compartment, and will cost then less than one oil-lamp. The system is gradually finding its way into the carriages on our leading railway systems. The Midland Railway Company has 121 coaches fitted on this system, the Great Western 38; the South-Eastern, 154; the Metropolitan District, 301; the District, 350; the London and South-Western, 553; the Great Eastern, 592; the Caledonian, 208; the Glasgow and South-Western, 250: the North British, 36, and the Mersey Railway, 56. This gives a total of 2,659 coaches fitted on this system on British lines; but the number thus lighted in all countries is over 17,500, besides which there are locomotives fitted with head-lights burning Pintsch's gas.

ELECTRICITY MAN'S SLAVE.*

By Thomas A. Edison.

THE TELEGRAPH, THE TELEPHONE, THE ELECTRIC LIGHT AND THE ELECTRIC MOTOR.

AMONG the many factors which have developed commerce and industry and stimulated all the forces of progress during the last half century, none has played a part so radical and essential as electricity. Hardly a single nerve or fibre of that complex body which we call society, that has not thrilled and vibrated with its influence. It has strengthened the bonds of international amity; it has quickened all the methods of trade, and lent ten-fold precision and celerity to the innumerable agencies by which it works; it has breathed new vitality into the arts and sciences; it has even warmed and strengthened the social forces; and in a word one may justly claim for it such a universal stimulus, as cannot be credited to any other purely physical agency in the world's history.

It is not yet fifty years since the invention of the electro-magnetic telegraph, made by Professor S. F. B. Morse, was first put into operation between Washington and Baltimore. To-day there is hardly a hamlet so small and remote that a telegraph station does not link its inhabitants with every point of the civilised world. The crude apparatus first used by Professor Morse has been again and again improved on by subsequent inventors in the same field.

Only a few years elapsed after the success of Professor Morse before the first submarine cable operated in America was laid between Cape Ray and the shores of New Brunswick. This achievement in 1852 suggested to Mr. Cyrus W. Field, we believe, the connection of the New World with the Old, by means of a submarine cable. The history of the first Atlantic cable laid, the jubilee over its triumphant completion on August 6, 1857, its short life of less than a month, the pluck and energy displayed by capitalists in their endeavours to lay a second cable nine years later, the failure of this second effort, the ultimate success attained by the laying of the Anglo-American Telegraph Company's, and its final opening as a medium of public traffic on August 26, 1866—all these things are sufficiently well known to most of our readers.

Closely connected with the development of the telegraph came the invention of the speaking telephone, this being the logical consequence of the former. When it was once found possible to transmit signals over a length of wire by means of the electrical fluid, it was certain that sooner or later experiments would be made ultimately with a view to employing the same agent as a means of transmitting articulate speech to a long distance. These experiments reached a successful conclusion in 1876-77 by the invention of the magneto receiving telephone by Professor Alexander Graham Bell, and the carbon transmitting telephone of the writer of this article. Many others have laid claim to the invention of the telephone, or to so-called improvements on the original devices. But so far the only instruments commercially successful are the Bell receiver and the Edison carbon transmitter, now universally accepted throughout the world.

Coincident with the development of the speaking telephone, the electric light was first brought to a practical success by the illumination of the Avenue de l'Opéra in Paris by the Jablochkoff candle in 1878. Prior to this but little had been done in the way of electric illumination on an extended scale. The exhibition made in Paris gave a great impetus to lighting as a business. From that time to the present the progress has been marvellous and rapid, only second to that of the telephone.

Many inventors, among them Staite, King, Kossloff, Swan and Sawyer, had previously been experimenting with a view to making useful lamps giving light by means of incandescence. But these experiments had been based on fallacious theories, and were foredoomed to failure. The writer was led to the invention of the filament lamp by keeping in mind the commercial necessities of the case as applied to a lamp forming but one unit of a complete system. His object, therefore, was not merely the device of an electric lamp; he aimed to invent a system of electrical illumination which could be operated on an extended scale in the same manner as in the business of gas illumination; to find some means by which electrical energy could be turned into light, and that light be used for household purposes and sold by meter-record—in short, a system superior to that of gas and able to compete with it commercially. The final result of these experiments was the invention of a complete incandescent system, and the starting of a Central Station in New York at 3 p.m. on September 4, 1882. Then for the first time electricity for the production of light was supplied and sold on a meter. This station has been in operation since, night and day, and has been followed by the establishment of other stations, both in this country and in Europe.

In addition to the foregoing, electricity has been brought to the aid of metal-workers for the purposes of electro-plating and electrotyping; it has assumed a place in our houses for the operation of call-bells and annunciators; for protection against burglars; and for the correction of our clocks and other purposes.

Yet though so much has been already done in the last fifty years in the way of electrical development, the writer is confident that far greater progress will be made in the future. We stand to-day only on the threshold of its tremendous probabilities. The uses to which the electrical energy can be adapted are so numerous that the present generation hardly dreams of them. Nothing of any startling character can be expected of the electrical telegraph. The business has been so long established, the improvements are so numerous, that very little remains to be done. Some day there will be, no doubt, a sextuplex system, which will make one wire do the work of six. While none so far tried has succeeded commercially, the expanding magnitude of telegraphy makes it a necessity. This will enable the present telegraphic plant to do more work, and lessen the investment necessary for the instalment of any future plant. The necessity for economic running expenses must lead to the use of a system of autographic telegraphy, which will enable the telegraph companies to dispense with most of their skilled labour.

The development of the telephone is in its very infancy. In the first instance, those in the centre of cities alone had the advantage of telephone service; then the suburbs were reached, and later on towns adjacent. The service in cities is by no means satisfactory, and between cities and towns adjacent it is far more inefficient. The business has reached such magnitude that it has outgrown the present equipment. The company controlling the telephone business in this country fully recognises this, and is working with all the talent which money and interest can obtain to improve the service. The result will be greatly to the advantage of the public, and consequently to the commercial development of the telephone.

The efforts made with a view to long-distance telephoning have already proved quite satisfactory in a commercial way, and promise excellent results. Conversation has been conducted between Cleveland and New York, and is now daily

* From the *New York Tribune*.

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carried on between New York and Boston to a limited extent. The great difficulty in long-distance telephoning is the loss of the current by static induction on the earth and wires in close proximity. If a single wire could be placed sufficiently high as to amply clear all the mountain tops, one could whisper around the world with perfect ease; or if a wire could be stretched from the earth to the moon, the connection would also be adequate. Perfect results were recently obtained on a Government line in Arizona, a distance of about a thousand miles, the wire stretching over a treeless space of country, more perfect far than can now be had between New York and Hartford. The loss of the electrical energy by static absorption and the running together of the electrical waves, is the fact that utterly precludes the possibility of sub-marine telephoning across the ocean. One thing, however, is now certain, that the time is close at hand when the telephone will be perfectly successful in an unbroken circuit for a distance of at least 300 miles; and that a subscriber will be able to communicate with 75,000 commercial houses. More than this, even, it is probable that by means of repeating stations, communication can be had over all parts of the United States.

The changes wrought by the telegraph and telephone will be equalled, if not eclipsed, by the transformation wrought through electrical lighting. Two years' experience proves beyond a doubt that the electric light for household purposes can be produced and sold in competition with gas.

It is immaterial whether the electric energy is used for light or for other purposes. It is so easy of control, the apparatus required so inexpensive, that it can be used as a motor-power for purposes innumerable. In a house it can be utilised to drive miniature fans for cooling purposes, to operate a sewing-machine, to pump water, to work a dumb-waiter or an elevator, and for a hundred other domestic uses which now require personal labour. In places where small steam-engines are used at great expense, owing to the special attendance requisite, the electric motor will be invaluable. Electricity as a lighting agent has the great advantage over gas that it can be used at will for motor purposes, and that its operation for the latter purpose is as simple as for incandescence, which is done by the mere turning of a key like a gas-cock. The function of electricity as a motor for household purposes will be hardly less useful than its value in illumination.

The great problem to be solved, however, by the physicist and electrician, before the art of electrical application attains its ultimate triumph, is the direct production of electrical energy from coal. The dream of certain French and German scientists that it may be transformed directly from the solar energy is a wild chimera, or at least it is remote and untrustworthy; but that it will be derived in some simple and inexpensive way directly from coal, which is solar heat and light stored up by nature, the writer believes to be a certain fact. The present methods of producing electricity are, at their best, very cumbersome and expensive. Expensive boilers, engines, and dynamo-machines are the media through which the carbon of the coal is transmuted into electricity, and with enormous waste at that. A large amount of expensive labour, too, is needed, so that with the cost of the plant and of the labour to operate it, the ultimate product is very costly. Once, however, the secret of the direct production of the electrical energy from coal is discovered, a marvellous revolution will take place. The cost to the consumer then will be very small. From one great central station in a city electricity will be furnished to give light, heat, and power to houses, stores, public buildings, factories and workshops, and at so reduced a cost as to materially lessen the expenses of life and work. This is something more than a dream. It is a future fact which many now living will probably see realised. Such a direct transformation of coal into electricity would utilise 80 per cent.; now by the process of turning the energy of carbon into heat, heat into energy of motion, and this into electrical energy, at least 90 per cent. is lost.

Electricity as a motive power will not be confined to household or factory purposes. It has already been successfully used (for experimental purposes) at Berlin, Paris, Port Rush (Ireland), and by the writer at Menlo Park as a motive power on a railroad. These various experiments have perfectly proven the practicability of the electric locomotive, and indicate that it will be largely adopted in the future in place of the steam locomotive.

Various experiments have been made with a view to the electric propulsion of carriages, cabs, drays, &c. The drawback has been that the power has been obtained from secondary or storage batteries, the depreciation in which is so rapid, and the weight of the receptacle so great, that until some radical improvements are made in connection with the storage of electricity, or the production of the same directly from coal, we cannot hope to see the subtle fluid used as a means of propelling street conveyances. Still daylight begins to shine on the problem, and the writer has no doubt that eventually most of our trucks and cabs will use this power. When this time comes we shall find the scope of electricity vastly widened, and see carriages without horses, yachts without steam or sail, and many other novel adaptations. The problem of aërial navigation, too, will then be easily solved.

The vast deposits of rebellious ores, which for the want of an economical method of working are to-day practically useless, will probably at some date not far hence yield to man the precious metal they contain by assistance of electricity. Though the experiments have not been very successful, enough has been done to show that there will be eventual success.

Such, briefly told, are the marvels of electricity, as already accomplished, or as marked out on the sure lines of scientific foresight. If the story could have been told as a prophecy fifty years ago, it would have dazed even the most adventurous mind. Yet the other half of the story hidden behind the veil will not be a jot less wonderful. The writer, in reviewing what he believes from a long and absorbing study of the problems of electricity, has only touched on those phases of development which experiment has shown to be within the grasp of the scientific inventor. To discuss its possibilities would bring into play a line of speculation seemingly more akin to the dreams of the poet than to the sober judgment of the practical worker.

Making Butter by Electricity.—If the announcement made by a French contemporary remains true in practice, butter churn-makers will, perhaps, have to turn their attention to the construction of other things—perhaps dynamo-electric machines of very low electro-motive force. According to a patent taken out by Mr. A. C. Tichenor, milk is introduced into a vessel of special form, and into it are placed a pair of electrodes, and a current thus passed through the milk. Butter is formed in little balls on one of the electrodes, and it is said that to extract the butter from forty-five litres of milk the current from a dynamo-electric machine equivalent to that of about forty Daniells for from three to five minutes is all that is required. With such a current the balls of butter are sufficiently voluminous to detach themselves from the electrode and float to the surface of the milk. The butter thus obtained has to be worked in a baratte, or something of the kind, so as to work the small pieces into a compact mass. The patent also mentions the electric manufacture of cheese and of removing the bad taste of butter that has turned rancid. We do not know how far the indications of the patent specification have been verified.—*Engineer.*

THE KALEVALA.

By Edward Clodd.

I.

THE important work of Mr. Andrew Lang on "Custom and Myth" demanded so full a notice in these columns, that reference to certain essays which were included in that volume, but which lay somewhat outside its main purpose, was excluded. Among these essays is a reprint of Mr. Lang's paper on the national poem of the Finns, the "Kalevala," which appeared in *Fraser's Magazine* some years ago. This paper merited reproduction, and thanks are due to the author for rescuing so skilful and vivid an analysis of that remarkable and, among ourselves, neglected epic from the oblivion of a dead serial. The interest of the present writer in the "Kalevala" was aroused by a visit to Finland in the summer of 1878, when, in the balmy August evenings the children of the household sang the songs of Suomi (*i.e.*, the swamp or sea-land, the native name of the country) on the waters and among the pines and birches of that land of lake, fen, and forest, and when his accomplished hostess Englished the runes which tell the exploits of Wäinämöinen and his fellow-heroes. He is now engaged, in conjunction with Mr. Kirby (of the British Museum), to whom, in fact, the lion's share of the work at present falls, in preparing a translation or paraphrase of the "Kalevala" for English readers; and, meanwhile, the readers of Knowledge may find their interest in that poem awakened by an epitome of its contents, prefaced by some general remarks on Finnish mythology.

Finland, *i.e.*, Fen-land, is little known to the tourist; it lies out of the beaten track of the "personally conducted," but both scenery and people well repay the journey thither. The most picturesque route is *viâ* Stockholm, and thence by sea to Wiborg. Points of interest and curiosity are ever opening out as the little steamer threads its way among the rocklets that fringe the gulf in such numbers as to make navigation by night impossible, and the leisurely voyage leaves time for halting to spy the nakedness of primitive Åbo, and to see in detail the 'varsity town of Helsingfors, majestically uplifted in the rear of the guns of Sveaborg, that guard the narrow and winding channel. The area of Finland exceeds that of the United Kingdom, but its population is barely two-thirds that of Scotland. One third of the country is lake and river, swamp and morass, the remainder is forest or patches of cleared ground, if that can be called cleared which, after the uprooting and burning of the trees, is everywhere encumbered with masses of granite as outcrop, or erratic boulder, so that but a scanty harvest rewards the rude husbandry, and the peasants have in hard times to mix bark with their rye bread. The ruling class is Swedish by descent, although Finnish to the core, for both high and low, although more or less racially distinct, have been welded together by the struggles of centuries, and by the common liberties enjoyed during the six or seven centuries under Swedish rule. After long resistance, Finland was ceded to Russia in 1809. The conqueror astutely encouraged the national feeling to counteract hankerings after re-union with the Swedes, preserving the ancient constitution, with its rights of legislation and taxation, and thus inviting the purely Finnish element to come more into play.

As might be expected, the inhabitants of the Baltic provinces are of more mixed race than those in the inland districts. But both may conveniently be classed as non-Aryan, and as more nearly allied to the Tatar-Mongolian race than to any other known group, although their exact relation, like that of the Magyars, to the pre-Aryan dwellers dwellers in Europe is obscure. The language of the more remote provinces is still in the agglutinative stage—*i.e.*, the words are loosely joined together instead of being fused, the union is mechanical rather than chemical; but that of the Baltic provinces has, under foreign influence, almost reached the inflectional stage.

The fantastic mythology of the Finns has not received among English students the attention which it deserves. As the heritage of a people allied to races dominant in Eurasia before the Aryans (who may themselves have sprung from their loins) appear upon the scene, it would contain more primitive elements, and thus throw light on the intellectual condition of an ancestry more remote than ours. Moreover, it would take firm root in an undisturbed and isolated country like Finland, whose physical features—long indented coasts, numberless islets, granite hills, stretches of marsh-land, sandy moors, dense, gloomy forests, dark, turbulent waters, and long, sad, silent winters—fed the weird imagination of a people in whose blood ran dread of the Shaman and all his spells and incantations. In fact, save that general personification of phenomena which lies at the base of all primitive interpretation of them, the Finnish mythology has apparently little in common with any other, that of the non-Aryan Esthonians on the opposite shores of the Gulf of Finland excepted. Early mythology and theology are one, and we find among the ancient Finns the worship of natural objects, all moving things being credited with life, and all their relations regarded as the actions of mighty powers. So far as the gods of their Pantheon can be sorted from the confused and contradictory mass of oral traditions, it would appear that the chief deity, a kind of *primus inter pares*, is Jumala,* the impersonal heavens with all their varied phases. Personified, or detached from the visible, he appears as the many-titled Ukko† (itself once a general term for gods)—Ancient One, God of the Sky, The Thunderer, and so forth; who is husband of Ilmatar, the daughter of the Breezes of the Air, and also father of the chief heroes of the Kalevala, Wäinämöinen, and Ilmarinen, broadly resembling the Norse demi-gods Odin and Thor respectively. Ukko, whom we shall meet in the Kalevala, is one of a crowd of departmental, immortal deities, more or less incarnated, arranged in pairs, like the ancient classic gods, and ranked in the order of the importance of their functions. Philajatar, the goddess of the mountain-ash, is the servant of Tapio, the forest-god; but, nevertheless, her dominion is an *imperium in imperio*. "Every god," says Castrén, in his "Finnish Mythology," how petty soever he may be, operates in his own sphere as a substantial, independent power, or, to speak in the spirit of the runes, as a self-ruling householder. The god of the polar-star only governs a quite insignificant spot in the vault of heaven, but on this spot he is his own master or host."

So we find Pæivæ, sun-god; Paun, his son, god of fire Koïtt, god of the dawn; Kun, moon-god; gods of the leading stars, serene and stately deities. Among the powers of the upper air are the mystic maidens Luonnotars, three of whom were created by Ukko rubbing his hands on his left knee-cap. How they became the "mothers of iron" will be told in the analysis of the Kalevala. Udutar is the goddess of fogs and mists, the finer descriptions of which she passes through a sieve before sending them on the earth. On that adoration of the water which among the Finns held place second only to that of the air,

* *Id est*, Thunder-home, from *Jum* (pronounced Yoom), an onomatopœia for thunder, and *la*, a local suffix.

† Cognate with Magyar, *agg*, old

Castrén remarks, "It could hardly be otherwise, for as soon as the soul of the savage began to suspect that the godlike is supersensual, he reverences and values matter the more highly the less compact and the more ethereal it is. He sees, on the one hand, how easy it is to lose his life on the roaring waves, and, on the other hand, he remembers that from these same waves he derives the gifts that form a means to prolonging life."

The customs and legends which were the outcome of water-worship among the Finns and Esthonians are numerous and interesting, and, as illustrating Castrén's remarks, we have the following beautiful legend of the Esthonians concerning Lake Eim* :—

"Savage evil men dwelt by its borders. They neither mowed the meadows which it watered, nor sowed the fields it made fruitful ; but robbed and murdered, insomuch that its clear waves grew dark with the blood of the slaughtered men. Then did the lake mourn, and one evening it called together all its fishes, *and rose aloft with them into the air.* When the robbers heard the sound, they exclaimed, 'Eim hath arisen ; let us gather its fishes and treasures.' But the fishes had departed with the lake, and nothing was found on the bottom but snakes and lizards and toads. And Eim rose higher and higher, and hastened through the air, like a white cloud. And the hunters in the forest said : 'What bad weather is coming on !'—the herdsman : 'What a white swan is flying above there !' *For the whole night the lake hovered among the stars,* and in the morning the reapers beheld it sinking. And from the swan grew a white ship, and from the ship a dark train of clouds ; and a voice came from the waters : 'Get thee hence with thy harvest, for I will dwell beside thee.' Then they bade the lake welcome, for it would only bedew their fields and meadows ; and it sank down and spread itself out in its home to the full limits. And they set the bed in order, and built dams, and planted young trees on the bank to cool the waters. Then the lake made all the neighbourhood fruitful, and the fields became green, and the people danced around it, so that the old man became joyous as a youth."

Ahto, the Finnish Neptune, is, like the other chief deities, an aged man, wearing a robe of foam, and dwelling with his wife, Vellamo, in Ahtola, a palace at the bottom of the sea, filled with treasure acquired through fragments of the sunken, wonder-working Sampo, of which more hereafter. Lake and river gods, children of Vellamo, abound, rendering for the most part kindly service to men, as in the episode in the Kalevala when Pikku rose from the waters to cut down the oak whose branches shut out the light of day. The earth was regarded in a two-fold aspect, as living and as life-giver, Maacema, mother earth, and Maanemo, mother of the earth. Following in her wake is a crowd of minor deities of trees, and plants, and cereals, of forest demons and sprites led by Hiisi ; and turning to another class presiding in another sphere we have the gods of love, of sleep, of dreams, of death, and of the invisible world ; of disease, of the healing arts, spinners of nerves and veins ; then the domestic deities, the goddess of weaving, the house-spirits, bringers of ill or good luck, to be attracted or repelled by charms and observances. Traces of animal-worship, especially in that northern zone, of the bear ; of tree-worship, notably of the oak as God's-tree, and the ash ; of holy springs and hills, occur in the archaic poetry and in the songs of the Kalevala, while, as affecting every event in life, the belief in magic, which marks the lower culture everywhere, is persistent. Among the Finns belief in the power of magic words, especially when set in song, is noticeable, and of this the folk-songs supply many illustrations ; but the most striking are associated with the exploits of Wäinämöinen, the principal figure in the Kalevala.

The peculiarly interesting manner of the recovery and arrangement of the several parts of that epic claims some reference before an account of it is given.

* Grimm, D. M., 599.

FIRST STAR LESSONS.

By Richard A. Proctor.

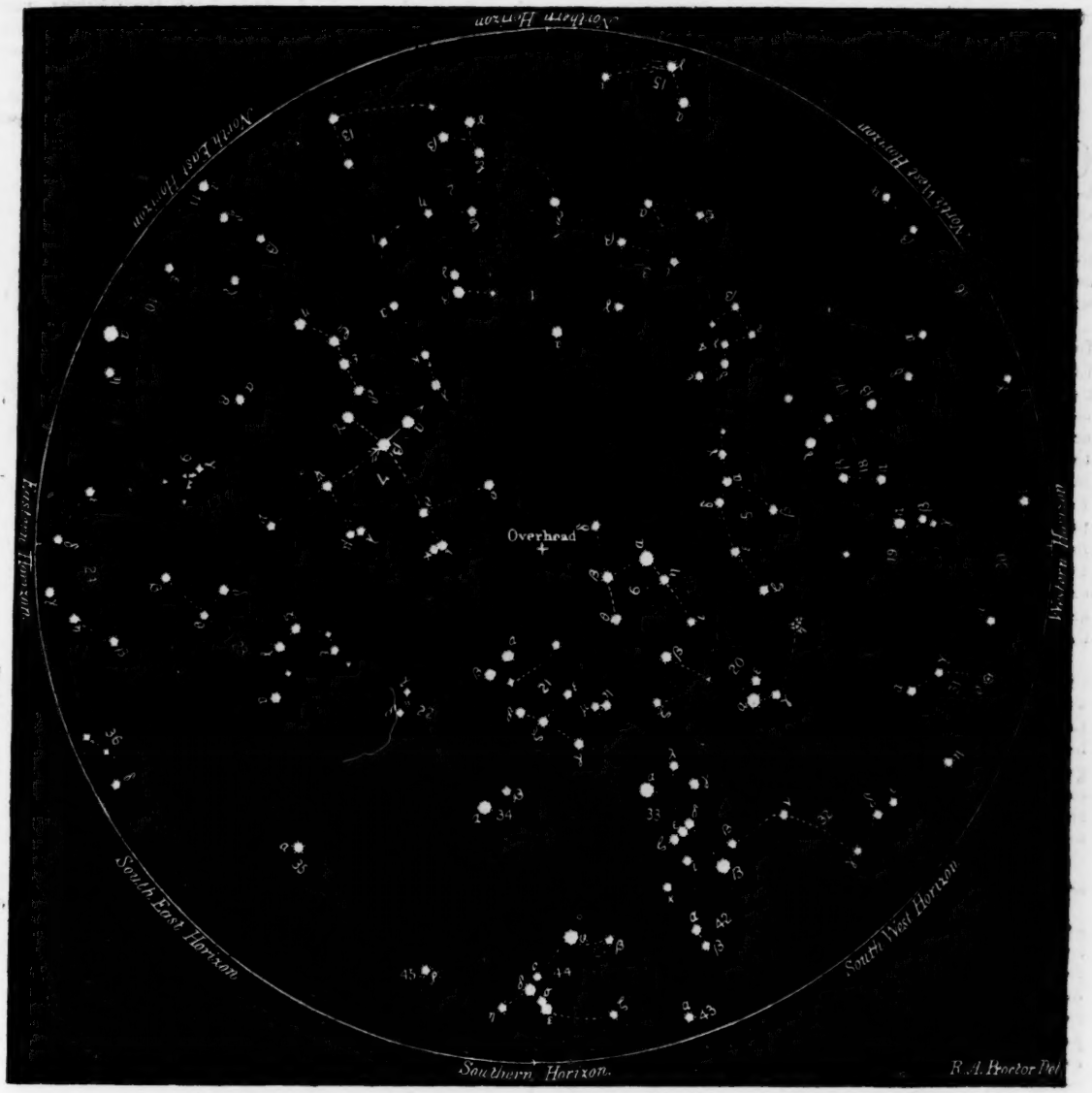
INVERTING the map, and so bringing the northern horizon downwards, we see that *Ursa Minor*, the *Little Bear* (1), extends so that the *Guardians of the Pole* (β and γ) bear from the *pole star* α, in the direction of the minute-hand of a clock about eighteen minutes past an hour. *Draco, The Dragon* (2), curves round the Guardian stars on the right, and thence below the Little Bear, the head of the Dragon being marked by the stars ξ, γ, and β. It has always seemed to me that the ancients recognised in γ and β the eyes of the Dragon, and that the fourth magnitude star shown below, belonging now to Hercules, originally belonged (*also*) to the Dragon and marked his snout. Towards the west of north (that is the left as we face northwards) we observe the stars of *Cepheus* (3), not very conspicuous, nor in the least like a king. Below we see close to the horizon the bright star Arided, α of *Cygnus the Swan* (15). Midway between the zenith and the horizon, towards the north-west, lies *Cassiopeia* (4), the *Seated Lady.* The stars α and β mark the top rail of her chair's back, so that she is now in an inverted position. Below her and towards the west or left, lies the constellation *Andromeda* or the *Chained Lady* (17). The head star α, for she also is inverted and her head lowest, originally belonged also to *Pegasus*, the *Winged Horse* (16), and was δ of that constellation ; γ and β of Pegasus can be seen close by the horizon.

Nearly due west and high up we see *Perseus*, the *Rescuer* (5). He is represented holding the bleeding head of Medusa, marked by the strange variable Al Gol, the Demon Star, which was doubtless known to the ancients as a variable star. Below we see *Triangula* the *Triangles* (18) and *Aries* the *Ram* (18), while the irregular and not very conspicuous constellation *Pisces* the *Fishes* (30) occupies the western horizon.

Again looking high up, close to the point overhead, we see *Auriga*, the *Charioteer* (6). Below this towards the south-west is the fine constellation *Taurus*, the *Bull* (20). *Orion*, the *Giant Hunter*, (33) faces the Bull, whose head is marked by the stars α, γ, and ε. Below him is *Lepus*, the Hare (42) and *Columba* the *Dove* (43), on whose left prances on his hind feet the *Greater Dog, Canis Major* (44), easily recognised at all times by the splendid *Sirius* (α).

Due south and high up we see *Gemini*, the *Twins* (21), below which is *Canis Minor*, the *Lesser Dog* (34), while towards the left of Gemini, we see the group *Præsepe* or the *Beehive*, between the little stars γ and δ of *Cancer* the *Crab* (22). Above the south-eastern horizon is a great vacant space—where but two stars are shown in the map, one belonging to *Argo* the *Ship* (45), the other *Alphard* or the *Solitary One*, to *Hydra* the *Sea Serpent* (35).

Extending from Cancer towards the eastern horizon are the stars of *Leo*, the *Lion* (23). The star α, or Regulus, marks the Lion's heart. A group of stars in this constellation has been compared to a sickle, α and η mark the handle, η, γ, ζ, μ,and ε the blade. This group is called the *Sickle in Leo.* Due east on the horizon is a part of *Virgo*



NIGHT SKY FOR FEBRUARY (First Map of Pair),

Showing the heavens as they appear at the following hours:—

February 6 at 10 o'clock.	February 17 at 9¼ o'clock.	March 1 at 8½ o'clock.
February 10 at 9¾ o'clock.	February 21 at 9 o'clock.	March 5 at 8¼ o'clock.
February 14 at 9¼ o'clock.	February 25 at 8¾ o'clock.	March 8 at 8 o'clock.

the *Virgin* (24)—the five stars β, η, γ, δ, and ϵ, form a nook which has been called, for reasons unknown to me, the *Retreat of the Howling Dog (female of the species)*.

High up towards the north-east we see the stars of *Ursa Major*, the *Greater Bear* (7). The Plough (or Dipper, as they call the group in America) is midway between the horizon and the point overhead. Below the body of the Plough, a little to the right, we find *Canes Venatici*, the *Hunting Dogs* (8); and between that group and Virgo lies *Coma Berenices*, the *Hair of Queen Berenice* (9). Then sweeping the horizon from east to north we came to *Bootes*, the *Herdsman* (10), *Corona* the *Crown* (11), and *Hercules* the *Kneeler* (13).

[A fortnight hence the second star of the map will appear. It will not be accompanied by any description, because the groups will have changed little from their positions in the present map. But the list of constellations with their numbers will be appended.]

The Inventions Exhibition.—The United States Senate, on the motion of the senator from Connecticut, has decided that a commissioner shall be appointed to represent that country at the coming International Inventions Exhibition, who shall have power to make the necessary rules and regulations; and further, that exhibits may be prepared in the Patent Office, and that Government vessels may transmit exhibits to the Exhibition free of cost. A sum of 25,000 dols. has been appropriated for general expenses.

CHAPTERS ON MODERN DOMESTIC ECONOMY.

XV.—THE FRAMEWORK OF THE DWELLING-HOUSE.

GENERAL PRINCIPLES OF CONSTRUCTION—(*concluded*).

OUR necessary digression, or rather reversion to the question concerning the rational disposal of household waste-waters last week, prevented us from completing our remarks upon the furniture of the ordinary form of closets. In a former article, we gave a full digest of the principles to be observed regarding the relative position and construction of those compartments both within and without the framework of the dwelling-house.

The principles to be observed with regard to closet furniture may be formulated, in order of importance, thus:—(i.) Absolute protection from the entry of sewer-gas. There are three ways in which sewer-gas can enter the house through the closet-fittings; (α) indirectly, on account of the defective ventilation and trapping of either the soil-pipe, or the house-drain, or improper passage of the latter into the street sewer—in any case, foul air is liable to be forced through the apparatus; (β) it follows that provision must be made against such an occurrence, and hence the fixtures of the closet should themselves be ventilated and trapped; (γ) in case of accident to the closet, or, as it often happens, to the connecting-pipe between it and the soil-pipe, a trap ought to intervene, and prevent the transmission of poisonous gas into the house.

(ii.) The form of apparatus must be such as to secure thorough cleanliness, and here (α) the material out of which it is made ought to offer the utmost resistance to the clinging of dirt; (β) the wash-down appliances should be so disposed that unnecessary waste of water ought to go hand-in-hand with thorough flushing, so that, in extreme cases, decomposing materials cannot by any possibility retain a hold anywhere; (γ) every part must admit of being taken to pieces and easily cleaned when desired, and this, therefore, necessitates provision for inspection, as well as gas-tight jointing of the detachable parts.

As house-slops are generally emptied into the basin, the apparatus ought to possess not only a hinged seat, but a special slop-top. In all cases the top and the seat should rest accurately upon the rim of the basin, otherwise liquid excreta is apt to find its way into the safe beneath the seat, and outside the apparatus altogether, there to decompose and puzzle, not only the inmates of the house, but even professional plumbers, as to the origin of the nuisance.

An adequate history of the rise and progress of the hydraulic system would necessarily include the special development of closet furniture; and this we shall trace in our future illustrations. In its early days, when household cesspools were in vogue, the furniture consisted of merely a perforated seat; then came a seat with a basin and discharge-pipe, and water was naturally used to rinse out the simple arrangement. The necessity then arose, in more or less densely-populated districts, for the continuous removal of the waste matters, and thus the great water-sewerage system was established. As in all other departments of domestic economy, surrounding circumstances prevailed unequally to modify the details, and every form of apparatus may now be found in use, from the primitive seat and cess-pit to the elaborate "Lambeth" valvate and flush-out machines, leading to complicated systems of tubes.

Most unfortunately, there are still hundreds and thousands of cases in our very midst, where the hydraulic system can never hope to become perfect. In the neighbourhood of Kingston, Mortlake, Richmond, and, indeed, throughout the whole borderland of the Thames, new streets are constantly being opened and houses erected. Many such streets have continued year after year without any public sewer at all, and yet all the houses are furnished with house-drains. Where does all the sewage go to? As an instance we may refer to a street not far distant from Richmond, as a typical example of the rule, and not the exception, in outer London. The houses are all well-built, averagely well-ventilated, and "provided with every convenience;" they let well, and yield an income of from £40 and upwards *per annum*, so that they are not to be classed amongst the dwellings of the poor, which are in an even more deplorable condition. One of the "conveniences" consists in a house-drain from each house which joins that of one or two neighbours, to discharge into a concealed cess-pit beneath the pathway in front of the dwelling, and these accumulations are cleared out at the caprice of the landlord, to suit his own convenience and pocket, for there is no sewer, and no prospect of a sewer.

Offshoots from that comparatively salubrious street consist of smaller houses in subdivided rows, which are of the average rental value of £20 a year. The sections of each row are furnished with a common drain, into which long hopper-basins, without the shadow of a trap, open; so that, in the event of zymotic disease in one house, all the others are open to attack through the most offensive and potent pathway that the germs can take, and thus all the most favourable conditions for the outbreak of an epidemic are fulfilled. At intervals the drain gives off effluent branches, which terminate in cesspools beneath the pavement or its substitute, and constantly give trouble. It is only a few days since a case came before our notice in which a foot-passenger and an inquiring policeman came to grief over one of these filthy pools.

Now, it is out of the power of the local authorities to prevent these evils unless they incur the enormous expense of immediately constructing public sewers in every existing deficient street. They cannot make present house-owners subscribe to this without gross injustice, but they can do so for future streets. If they do put such a measure into force, it is obvious that no new streets would be erected, at least, not for the housing of the working classes, and they would, therefore, slowly, but surely, drive back the crowd to the metropolis, there to make things more hideous in the already overcrowded back-slums. But even if they could, by an almost impossible effort, provide a sewer for each street without an increased taxation, what are they to do with the superabundant filth? As we have taken a concrete example, in illustration of our remarks—which are nevertheless true for every other suburb of London—let any of our readers question the Board at Richmond. He will learn, that without any accession to the present sewage, they are in a dilemma, and cannot hope to escape therefrom in these unregenerate days, when even puny miraculous efforts are only attempted by knaves and jugglers. Yet, there is a perfect, simple, let us say *natural* remedy open to them and sufficient to meet all wants,—financial, sanitary, and social; and that power for good is to be sought for in the "dry system."

This brings our discussion of general principles to a close; in our next we shall institute a series of practical illustrations in support of those principles.

The Australasian statistics for the year 1883 have been published by the Government Statist of Victoria. The total population of the seven Australasian colonies is estimated at 3,012,451, distributed as follows:—Victoria, 917,310; New South Wales, 843,389; Queensland, 267,865; South Australia, 299,012; Western Australia, 31,233; Tasmania, 124,350; and New Zealand, 529,292.

Editorial Gossip.

Stellar photometry, or the quantitative measurement of the relative amount of light emitted by the various stars, is a branch of astronomy in which very considerable progress has recently been made; and I am glad to see, from a recently-published report presented to the Philadelphia Meeting of the American Association for the Advancement of Science, that an International Committee on Standards of Stellar Magnitude is now at work on this subject. The committee point out what must, however, be apparent enough, that it would be impossible, in the outset, to choose stars which should represent any assigned brightness or should be exactly of the 1st, 2nd, 3rd, &c., magnitudes. Even if the scale were made to conform to specified stars, subsequent measures would be sure to show that its divisions were irregular. What is, then, suggested is that certain suitable stars should be selected as standards; their relative light accurately measured, and that these measures should be expressed in terms of any convenient scale of magnitudes that may be finally adopted. The English sub-committee (consisting of five members of the Council of the Royal Astronomical Society) have taken charge of the lucid stars, or those visible to the naked eye. Stars from the sixth to the tenth magnitude are allotted to the German Astronomische Gesellschaft, ; while stars fainter than the tenth magnitude are assigned to the American Association. Possessors of very large telescopes, who may wish to aid in the last-mentioned branch of the work, will find a letter and four specimen charts by Professor Pickering, of Harvard College Observatory, Cambridge, U.S., in the current number of the *Astronomical Register*.

As is well known, a strong agitation (mainly, of course, originated and fomented by briefless barristers, attorneys without clients, and mad doctors whose private asylums don't fill) has been set on foot in this country for the establishment of a Court of Criminal Appeal. The scandals incident on our existing system of appeal in civil cases, might, one would have thought, have sufficed to show to what this must ultimately lead; but the Englishman is slow to learn anything, and is usually at the mercy of any quack or interested person who will promulgate his views in a sufficiently blatant manner. When we see how a powerful railway company, with hundreds of shareholders at its back, can reduce to utter ruin a plaintiff with an absolutely righteous cause of action against them, by dragging him from court to court on appeal, people less accustomed to defer to mere authority than we are, may well ask themselves whether there must not be something terribly rotten in a system which permits and even encourages such a gross abuse and hideous injustice as this. Merely as a matter of course, were this system of appeal extended to criminal cases, the overwhelming proportion of people who would be punished would be the poor, the rich man appealing in every case. However, it is needless to theorise on the subject, inasmuch as the *Newcastle Weekly Chronicle*, of the 31st ult., contains a letter giving details of the actual operation of this system of criminal appeal in the United States, which is so instructive that I reprint it *in extenso*:—

Sir,—I see in the *Weekly Chronicle* of Nov. 29 that a Bill has been before Parliament, and is likely to become law soon, to establish a Court of Criminal Appeal. I say God forbid such a court should ever exist in England. Let any person that advocates it come and spend over five years in America, as I have done, and see if he or she be of the same opinion after. In this country murderers by the hundreds are at liberty through such a court. In the city of Pittsburgh, some that were sentenced to death for most foul murders have escaped by second trials. On the other hand, a person was hanged in June last who was innocent. He was tried for murder, as accessory before the fact. The real murderer was hanged in April, and he protested that the other did not know that he was going to do it. A rich man, named Fowler, who was lynched twelve months since in one of the Western States, had committed seven murders, and been sentenced to death five times. It is deemed impossible in this country to hang a man who has money, and Fowler had 100,000 dollars to his name. Then there is Chicago, with an average of a murder a week, and only two hanged in eight years, and they were over poor to fee a lawyer to pull them through. Such like are the only ones they hang here. Let anyone come to this country to inquire, and he will find as many such cases as will fill your paper.—Yours, &c.,

An Englishman in America.

Rosco, Pennsylvania, U.S., Jan. 1, 1885.

English jurisprudence has, far too frequently, been made the laughing-stock of other nations by the capricious interference with capital sentences of conceited, squeezable, and incompetent Home Secretaries. So far, however, the law-abiding population of Great Britain has not been driven to lynch a man who has bought himself off the consequences of five successive murders!

The following paragraph, which appeared last week in the papers, is worthy of more attention than, I fear, it is likely to meet with:—

The Royal Institution.—At the general monthly meeting on Monday, Sir William R. Grove, Vice-President, in the chair, the special thanks of the members were returned for the following donations to the fund for the promotion of experimental research: Mr. Warren De La Rue, £100; Sir Frederick Bramwell, £50.

This is as it should be. If Dr. De la Rue and Sir Frederick Bramwell believe in the Endowment of Research, they are only consistent (in the language of the turf) in "backing their opinions." But this is a very very different thing to saying that John Smith, mason, shall pay extra for his tobacco in order that some gentleman may investigate the infra-red end of the spectrum; or that a tax shall continue to be levied on the tea drunk by the numerous family of Patrick O'Shaughnessy, hodman, to keep anybody in quasi-idleness hunting for "Cycles" in Sun-Spots and the Price of Oysters. Disguise it as we will, this is a gross infringement of the personal liberty of Messrs. Smith and O'Shaughnessy respectively; and one which they are justly entitled to resent in the strongest possible way. The private subsidy of investigation may—or may not—prove beneficial. The State payment of people to find something out (in contradistinction to remunerating them by results after it is discovered) is simply and solely to rob the wage-earning taxpayer to administer a genteel form of out-door relief to the impudent, the pushing, the self-advertising, and the quack generally.

I have heard an expression of opinion that the replies given in these columns under the head of "Letters Received and Short Answers" are occasionally rather more curt and sharper than there is any obvious necessity for them to be. Those who so think, though, only see the reply; never the communication which elicits it. No one but the editor of a journal like this can have any conception of the mass of heterogeneous correspondence which is showered on his devoted head; in fact, of the hundreds of letters he receives from persons of all social ranks, and of the most diverse intellectual capacities. I need scarcely say that people with fads and crazes make the most strenuous efforts to advertise their views through such a medium as Knowledge. Anti-Vaccinators, Anti-Vivisectors, Believers in Swedenborg, Vegetarians, Spiritualists, Earth-flatteners, and Immovable Earth men, Cosmogonists who are going to set the entire

scientific world to rights, men with chemical theories that account for everything, Regenerators of Society by the simple process of plundering the rich to bring them to the level of the poor, propounders of bran-new hypotheses on the nature and relations of Mind and Matter, Trisectors of Angles by Euclidean geometry, &c. Also readers anxious to teach me how to edit, Examinees who want equations solved, or sentences construed for them; beginners who have made a snuff-box from directions given in (say) the *Parlour Cabinetmaker*, and wish me to tell them why the hinges don't work?—and so on. And woe to me if I even venture to point out the fallacy of any of their assumptions to these gentry, or to hint that I am not a "crammer," or private tutor or the like, or in fact that I know my own business; the next week's post brings me sheets of abuse, which of course go into the wastepaper basket straightway. Another horrible nuisance is the man who will send an exposition of his theory (showing, we will suppose, that the pole star is very much nearer to the earth than the sun *is*), and requesting the Editor to write to him privately and disprove it! What idea such a person can have of the functions of an Editor or of the time at his disposal, it would be difficult or impossible to conceive: a remark which will equally apply to the writers of letters wanting me to sell to or buy from them numbers of this magazine. Having thus raised the curtain a very little way, I may perhaps express a hope that the next time the reader comes across an answer which he may feel tempted to regard as snappish, he will reflect that it has probably been written under circumstances of very strong provocation indeed.

Now, here is an example which has just reached me. The gentleman who favours me with it, Mr. J. Murray, is either the author, apostle, or prophet of what he calls "the P. D. theory." Whether "P. D." stands for Pure Delusion, Perfect Drivel—or what, I have not the most distant idea.

Editor

Dear, Sir; Feb 2end 1885

I cannot make out what the master wants to be at. In the last three years, he has torn up all the Theorys on astronomy both old and new, as he expounded them and showed the defect, he cast them all on one side, even his own has gone to the wall. I am pleased to think he has not giving up the P. D. system all together, as it is capable of showing how the planets form those fictitious loops or lines of demarcation, as they roll round there orbits without rolling a round the sun. Also, I am pleased to hear my Master speak of the Sun, having an influence over the contraction or over the contracted matter that envelop our earth; This is all the Sun can do, to expand that which is contracted, just the same as the light of our earth makes the moon form such a paracentric orbit or showes that our earth's light or influence over the moon must be as strong as the Sun's influence over the Moon. If the moon has no atmosphere how will you get the Sun's expansion to act upon the contraction if there be none, if the moon has little atmosphere it may be highly contracted, therefore, expansion can play a higher part, especially if there is no angles to bere the moon on its way. The P. D. system can show all the eccentric motions, that appears in the Heavens. Yours truely, J Murray.

I wonder whether "the P. D. system" can show all the eccentric motions that appear in the earth (say, for example, in the shape of letter-writing) as well?

Mr. W. August. Carter, of South Norwood, writes us:—I have lately made an analysis of the digestive organs of the Grey Mullet, which species of fish differs in this respect from all its congeners, it being partial to no food that has life. I find that it possesses a gizzard identical with that of a fowl, instead of the ordinary organic structure, which I believe is a unique feature amongst fishes. This peculiarity, however, is concurrent with the station of existence which it is preordained to occupy, and in accord with the nature of its food, which consists of soft, fat substances, such as decomposed refuse and vegetable matter.

Reviews.

SOME BOOKS ON OUR TABLE.

A History of Greek Mathematics. By J. Gow, M.A. (London: C. J. Clay & Son. 1884.)—Not a very attractive title truly, nor one giving promise of anything but the dryest reading; and yet it prefaces a book of the most curious interest, and an excellent example of scholarly research. The first portion of the work deals with the Aryan numerals and the origin of the Decimal scale; as also with Egyptian arithmetic, as having contributed to the subsequent development of that of Greece. In Part II. the history of Greek Arithmetic is dealt with in detail, and we learn under what disadvantages the Hellenic calculator laboured; one of the most potent being his imperfect form of notation. The progress of the theory of numbers is then described, and here the student will find a kind of *précis* of the arithmetical books of Euclid's "Elements," now wholly disused. In the succeeding chapters prehistoric geometry is traced to the expression of the relations between parts of space in terms of fixed units of length, area, and solidity; and as Greek geometry possibly, and even probably, may have had its origin in Egypt, a short account of what has come down to us of Egyptian geometry is given. The remainder of Mr. Gow's volume traces the history of the geometry of Greece from Thales down to Pappus, and very strange and interesting it is to note the rude inception of ideas familiar enough to the mathematician of to-day, and the increase of compactness and elegance in the methods of proof. This, in fine, is a work which supplies a real want in English literature, and which it is not much to the credit of our nation that we should have so long been without. It is only fair to say that it was worth waiting for.

An Elementary Treatise on Dynamics. By Benj. Williamson, M.A., F.R.S., and Fran. A. Tarleton, LL.D. (London: Longmans, Green, & Co. 1885.)—The authors modestly style this "an Elementary Treatise;" and so, as regards its preliminary portion, it undoubtedly is. The student, however, who will master the contents of the volume before us, will find that he has obtained a grasp of Kinematics, Kinetics, and the theory of Thermodynamics, which, for all ordinary purposes, will leave him but little necessary to acquire. The modern doctrine of energy is admirably explained, and the numerous very practical examples scattered through the text as admirably illustrate the exposition of the theoretical principles to which they are appended. With so much to admire, we are unwilling to make (what may appear) any merely carping criticism; but we wish that our authors had avoided the use of the expression "Centrifugal *Force*" in the second section of their fifth chapter.

Photo-Micrography. By A. Cowley Malley, B.A., M.B., &c. Second Edition. (London: H. K. Lewis. 1885.)—The practical microscopist is familiar with the difficulty often experienced (very notably with high powers) in re-detecting details of structure perceived under exceptionally advantageous circumstances; and of the paramount importance of preserving some delineation of what he has seen. Many observers are sufficiently expert in sketching, with the camera lucida, the neutral tint plate, or Sömmering's steel disc; but, unfortunately, their witness does not always agree together, and two draughtsmen will not unfrequently give very different sketches indeed of the same object. Of course, in one sense, photography furnishes an unerring record of what the instrument reveals, and it is to teach the worker with the microscope how to photograph his objects

that Mr. Malley's book is written. He takes no previous knowledge for granted, but begins at the beginning by describing the optical principles involved in the formation of the image, and the structure of the apparatus employed. The veriest novice may become proficient (of course, after practice) if he will study Mr. Malley's little work with care and attention. The photographs which illustrate it are of somewhat unequal merit.

Literary Success; being a Guide to Practical Journalism. By Arthur A. Reade. Wyman's Technical Series. (London: Wyman & Sons.)—Every one so far afflicted with the *cacoethes scribendi* as to desire to pursue journalism for a living should obtain Mr. Reade's work forthwith. It is crammed full of information, from cover to cover; and, moreover, of just the kind and amount of information needed by the literary aspirant. Reporting, leader-writing, reviewing, interviewing, "special" and war correspondence, art and dramatic criticism, editing, authors and publishers, and many cognate subjects, are dealt with in a series of amusing chapters. Our author earnestly counsels the would-be literary man to eschew the magazines and stick to the newspapers; advice sound enough, but in many cases resembling that of a physician who should order the wife of a cabman to go to Davos Platz for change of air. As, however, we began by saying, the whole book is so thoroughly useful and to the point, that the literary aspirant will do himself a real injustice if he omits to obtain it.

Souls and Cities. By the author of the Cheveley Novels. (London: W. Kent & Co.)—Anything more unlike the merely conventional novel than "Souls and Cities," it would be hard to imagine. The picture it gives of the inner life of a Nonconformist sect in a country place, with its meannesses and petty spites, curiosity and jealousies, shows a knowledge such as can only have been acquired from long personal observation. We will not destroy the reader's interest in this curious book by any outline of its plot. Suffice it to say that it is hard to decide which is the more noble character of the two, the Clergyman or the Congregational Minister.

Glass Painting, by Fred. Miller; *Pottery Painting*, by Fred. Miller. Wyman's Technical Series. (London: Wyman & Sons.)—We class these two excellent books together, treating as they do of cognate branches of art, the first of them of an art for which Mediæval England was famous, which then all but died out, but which, after a long period of decay, has comparatively recently been resuscitated. How effective—nay, how beautiful—glass-painting may be made, a visit to almost any one of our Cathedrals will suffice to show. Not alone, however, is painted glass applicable to ecclesiastical decoration. It may be made equally subservient to the adornment of the dwelling-house or the public building. Nor does the practice of painting on glass present serious difficulties to any one of moderately artistic taste; in fact, such a one, man or woman, need only study carefully Mr. Miller's most explicit directions to become a proficient in the art. Colours, materials, and processes are most fully described and as fully illustrated in the work before us, as which we have so far seen nothing so complete and exhaustive.

And the praise which we have given to Mr. Miller's essay on glass painting we may reiterate and extend to his instructions for painting pottery. As an elegant recreation and a valuable aid to the artistic furnishing of our living-rooms, painted china and pottery have for a considerable time held a prominent place. The intelligent perusal of Mr. Miller's second profusely-illustrated work will enable the reader to prosecute this charming art at once with pleasure and success.

Commercial and School Book-keeping. By A. F. Notley. (London: Bemrose & Sons. 1884.)—Young men about to enter on commercial life will find Mr. Notley a thoroughly trustworthy guide in the mysteries of single and double entry. The principles underlying the art of book-keeping are explained in language free from technicality, and a valuable innovation is made in the shape of two chapters containing instructions for taking out prime cost and depreciation, instruction which, so far as we are aware, have not appeared hitherto in any work published on the subject.

Helps to Health. By Henry C. Burdett. (London: Kegan Paul, Trench, & Co. 1885.)—Among the very numerous works on health which have had their origin, proximate or remote, in the South Kensington Exhibition of last year, we do not remember to have come across one so comprehensive as that of Mr. Burdett, now lying before us. It begins with the planning, arrangement, and furnishing of the nursery, and the care and treatment of its occupants; discusses the school with similar fulness; treats of bathing and clothing; of food and drink, and of work, rest, exercise, and recreation. Then the choice of a house is discussed, and the most minute details given as to structural details affecting its sanitary condition; the work concluding with a chapter on health resorts, and another on the sanitary powers and duties of the citizen. A rigid adherence to the rules laid down by Mr. Burdett in any given neighbourhood would render it a singularly unprofitable one for a doctor to commence practice in.

The Annual Report and Proceedings of the Belfast Naturalists' Field Club. (Belfast, 1884.)—This is a singularly readable and creditable account of honest work performed by the members of the most flourishing scientific society in the North of Ireland. It is, moreover, well illustrated—firstly with a plate of the Eocene Coniferæ from Ballypalady, and next with an extensive series of sketches of Irish cromlechs.

The Dramatic Review. No. I. (London, Feb. 1, 1885.)—If we may judge from the first number, the *Dramatic Review* ought to address a large public. Its articles are signed by men eminent in the literature of the drama, and its discussions of plays and players are at once unprejudiced and readable. A very fitting journal for all who find pleasure and recreation in the theatre.

The Asclepiad. By Benjamin W. Richardson, M.D. (London: Longmans, Green, & Co.)—Dr. Richardson's quarterly journal continues to sustain its reputation, and is filled with matter of interest to the medical profession. The layman, too, will find much to interest him in "Further Researches in Euthanasia for the Lower Creation," and in a short essay on "The Overpressure Question."

Britons, Awake! By A. B. C. (London: Kegan Paul, Trench, & Co. 1885.)—A spirit-stirring appeal to Englishmen to put our naval defences into a satisfactory condition, and to equip and man such a fleet as shall render us secure against the machinations of our loving Continental friends.

We have also on our table, from the Messrs. Cassell & Co., the first number of *Our Own Country* (with descriptions, very beautifully illustrated, of Salisbury Plain and Stonehenge, Leeds, and the Cinque Ports), *Cassell's Household Guide, Cassell's Popular Gardening, The Countries of the World, The Library of English Literature, European Butterflies and Moths*, and *The Book of Health.* Also, *The British and Colonial Druggist, Naturen, Society, Bradstreets, The Season, The American Druggist, The American Naturalist, The Kansas City Review, The Cinque Port, The Life-boat, Ciel et Terre, The Medical Press and Circular, The Journal of Botany*, and *The Technical Journal.*

XUM

THE FACE OF THE SKY.

From Feb. 13 to Feb. 27.

By F.R.A.S.

SOLAR activity seems to diminish but slowly, and beautiful groups of spots still continue to appear at intervals on the Sun's face. Map. II. of "The Stars in their Seasons" shows the face of the night sky. Mercury and Venus are both morning stars, but are still most indifferently placed for the observer. Mars is invisible. Jupiter, a little to the east of Regulus, towards which he continues to travel, is now visible all night long, and is—as he has for some time been—by far the most brilliant and conspicuous object in the sky. He comes into opposition to the sun at 8 a.m. on the 19th, so that he is about as well placed for the observer as he can be. The phenomena of his satellites occurring during convenient hours of the night, during the next fourteen days, are numerous and instructive. The student will note that prior to the 19th the shadow of a satellite precedes the satellite itself on the disc of the planet; and that after the 19th the satellite precedes its shadow (see Knowledge, Vol. V. pp. 126 and 127). On the 14th, then, Satellite II. will reappear from Occultation at 7h. 12m. p.m. On the 16th Satellite III. will disappear in eclipse at 7h. 21m. 48s. p.m., to reappear from behind the planet's limb at 11h. 9m. p.m. On the 17th, Satellite I. will be eclipsed, 49m. 16s. after midnight. On the 18th, the shadow of Satellite I. will enter on to Jupiter's disc at 10h. 5m. p.m., followed by the Satellite casting it only one minute later. The Satellite and its shadow will practically leave the opposite limb of the planet together 25 minutes after midnight. On the 19th, Satellite I. will be occulted at 7h. 15m. p.m. Satellite IV. will reappear from eclipse at 8h. 41m. 52s. p.m. The reappearance of Satellite I. from occultation will occur at 9h. 34m.; and the transit of Satellite II. begin at 11h. 38m., followed by that of its shadow at 11h. 40m. On the 20th, Satellite I. will pass off Jupiter's face at 6h. 51m. p.m., as will its shadow at 6h. 54m. On the 21st Satellite II. will be occulted at 6h. 32m.; pass behind the body of the planet into its shadow, and reappear from eclipse at 9h. 33m. 41s. On the 23rd, Satellite III. will be occulted at 10h. 49m. p.m. On the 25th, the transit of Satellite I. will begin at 11h. 50m., p.m. and that of its shadow at midnight. On the 26th, the same Satellite will be occulted at 8h. 58m., to reappear from eclipse at 11h. 26m. 24s. p.m. Finally, on the 27th, the beginning of the transit of Satellite I. *may* possibly be perceived at 6h. 16m. p.m. Its shadow follows it at 6h. 28m. It passes off the opposite limb of Jupiter at 8h. 35m.; as does its shadow at 8h. 48m. At 9h. 38m. Satellite IV. enters on to Jupiter's face; followed by its shadow at 11h. 34m. p.m. The student is recommended to pay particular attention to this phenomenon; inasmuch as it is the two outer Satellites which have been most frequently perceived as dark or even black spots on the brilliant disc of the planet. Saturn should be looked for now as soon after dusk as may be convenient; as, though he is still above the horizon during the working hours of the night, he is slowly, but surely, approaching the West. He still forms a rudely isosceles triangle with β and ζ Tauri. Uranus may be found during the later part of the night by fishing almost due east of η Virginis. Neptune is not worth looking for. The Moon is new at 2h. 21m. 8s. in the early morning of the 15th, and enters her first quarter at 10h. 31m. a.m. on the 22nd. Four occultations of fixed stars (one of them a notable one) occur during the next fourteen days. The first is of the 5th Mag. Star, 38 Arietis, which will disappear at the Moon's dark limb on the 20th at 7h. 41m. p.m., at an angle from her vertex of 211°, reappearing at her bright limb at 8h. 1m., at a vertical angle of 246°. On the 22nd Aldebaran will be occulted, and to this phenomenon the attention of the student is particularly directed, inasmuch as this is *the* star which has been most frequently seen projected on the Moon's limb. It will disappear at 5h. 17m. in the late afternoon at the dark limb, at a vertical angle of 20°, and reappear at 5h. 50m. p.m. at the bright limb, at an angle of 336° from the Moon's vertex. On the 23rd 130 Tauri, a sixth magnitude star, disappears at the dark limb at 11h. 3m., at a vertical angle of 145°, reappearing at the bright one two minutes after midnight, at an angle of 288° from her vertex. And, lastly, on the afternoon of the 26th, at 3h. 59m., the sixth magnitude star B.A.C. 2872 will disappear at the dark limb, at an angle from the Lunar vertex of 340°, to reappear at 4h. 24m., at a vertical angle of 286°. Up to noon to-day the Moon is in Capricornus, but at 4 o'clock this afternoon crosses into Aquarius, through which she is travelling until 6 p.m. on the 16th, when she enters Pisces. It takes her until 9 p.m. on the 19th to pass across this great constellation, and at the last-named hour she passes into Aries. This she quits for Taurus at noon on the 21st. Travelling through Taurus at midnight on the 23rd she arrives on the confines of the northern strip of Orion, and by the noon of the 24th has passed over this and entered Gemini. She leaves Gemini for Cancer at 2 a.m. on the 26th, and Cancer for Leo at 1 o'clock the next afternoon. There we leave her.

EPHEMERIS OF ENCKE'S COMET.

From Feb. 13 to Feb. 27.

Day of Month.	Right Ascension. H. M. S.	Declination North. ° ′
13	23 51 18	7 31·9
14	23 52 44	7 33·9
15	23 54 7	7 34·9
16	23 55 26	7 34·9
17	23 56 41	7 33·7
18	23 57 52	7 31·1
19	23 58 57	7 26·9
20	23 59 54	7 20·7
21	0 0 42	7 12·4
22	0 1 20	7 1·4
23	0 1 46	6 47·5
24	0 1 57	6 30·1
25	0 1 51	6 8·9
26	0 1 25	5 43·2
27	0 0 36	5 12·4

The short path shown in the above ephemeris starts from a point to the north-west of the 4th mag. star ω Piscium 1° 20′ due north of which it will be found on the night of the 14th.

Miscellanea.

Mark Twain intends, says the *Athenæum*, visiting England in May, for the purpose of giving readings from his own writings.

The number of passengers between England and France last year was 361,154, a falling off of 76,320, due, of course, to the cholera; 182,897 went by way of Dover and Calais, 96,304 of Folkestone and Boulogne, 67,156 of Newhaven and Dieppe, and 14,797 of Southampton and Havre.

Photographing the Larynx.—Dr. Theodore Stein has devised an ingenious and simple apparatus for taking photographs of the larynx which is likely to be useful in medicine and pathology, since it will enable doctors to study from day to day the changes of laryngeal disorders. It consists of a small incandescent lamp of 10 candle-power fed by a portable battery and cooled by Nitze's system of circulating water. This supplies the light which illuminates the throat and larynx. An image of the latter caught on a small mirror is received into a small camera on gelatine-bromide plates, the exposure being regulated by an electro-magnetic device operated by pressing a button.—*Engineering*.

The Aëronautical Society of Great Britain (which must be carefully distinguished from the Balloon Society) proposes to take a practical step towards the attainment of the end for which it was established, by holding an Aëronautical Exhibition at the International one to be opened at the Alexandra Palace next month. The Aëronautical Exhibition itself will however, not, begin until June. The objects for exhibition will be:—1. Models of designs for the accomplishment of aërial navigation by mechanical means only. 2. Models of designs for the accomplishment of aërial navigation partly by buoyancy and partly by mechanical means. 3. Models constructed to elucidate either of the two last objects, which are capable of flight and carrying their own motive power. 4. Machines constructed upon a scale calculated to carry a weight equal to that of a man, upon the principles advocated by the inventors. N.B.—The practicability may be demonstrated by the flight of a model of similar character, and of weight-carrying capacity sufficient to enable a judgment to be formed as to the probable efficiency of the large machine when actuated by the power necessary for its support and propulsion, whether by manual or mechanical methods. 5. Light motors. N.B.—It may be observed that light motors are in request for other purposes than aërial navigation. But for the latter object it is essential that extreme lightness shall be a condition. Therefore only a motor possessing that qualification in proportion to its power with the smallest consumption of fuel (in the case of steam) or other adjuncts, and capable of working up to one horse power at the least for twenty minutes, will be deemed deserving of the prize. 6. Balloons, navigable or otherwise. 7. Balloon material and appliances for propulsion or otherwise. 8. Kites or other aërial appliances of that character, for saving life at sea, for traction, or otherwise. 9. Objects of interest connected with aëronautics.

"Let Knowledge grow from more to more."—ALFRED TENNYSON.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

All Editorial communications should be addressed to the EDITOR OF KNOWLEDGE; *all Business communications to the* PUBLISHERS, *at the Office, 74, Great Queen-street, W.C.* IF THIS IS NOT ATTENDED TO DELAYS ARISE FOR WHICH THE EDITOR IS NOT RESPONSIBLE.

All Remittances, Cheques, and Post Office Orders should be made payable to MESSRS. WYMAN & SONS.

The Editor is not responsible for the opinions of correspondents.

NO COMMUNICATIONS ARE ANSWERED BY POST, EVEN THOUGH STAMPED AND DIRECTED ENVELOPE BE ENCLOSED.

QUESTION FROM FLATLAND.

[1588]—The question in letter 1585 is answerable from analogy thus:—

1 line has	2 end points		
1 simplest rect^{r} figure	has 3 lines and	3 corners	
1 simplest solid	has 4 planes	6 edges	4 corners

So they follow the co-efficients of a binonial, and

1 simplest sursolid	must have 5 solids	10 planes	10 edges	and 5 corners

(Four-dimensioned space mentioned by Paul, Eph. iii., 18.)

E. L. G.

THOUGHT AND LANGUAGE.

[1589]—One of the most pleasant features of KNOWLEDGE is the fair way in which mere outsiders are permitted to controvert statements in the teaching articles of the staff. On page 66, from "Now, when," to the end of the article, I submit that nearly all is erroneous.

We do not know by what animals the first-evoluted man was surrounded. It is held that he was originally an arboreal ape. Probably, then, if attacked by neighbours "thirsting for his blood," he would do like the other simians—swing into a tree by his hands, and get out of their reach. The apes have never developed any language or any weapons, yet *they* have not been eaten up for want of an "alliance, offensive and defensive, with others of their kind," or of articulate speech. I should like to know *what* reason there is for supposing that "primitive man was not nearly so large or powerful as the ordinary savage of the present day." I think all facts known point to the contrary. There is an admirable "Protest against Clothes," by an "Anthropologist," in the *Pall Mall Budget* for January 23, in which he preaches that clothes killed off the Tasmanians, and will do the same for the Papuans, if we force them to wear what does not suit their nature. Living in houses, again, is a most enfeebling practice. Ariovistus asked Cæsar how he could expect to beat men who had not slept under a roof for fourteen years. (They *were* beaten, just as the Arabs at Abu Klea, and for the same reason.) Men severely wounded almost always die in hospital, but recover if chance leaves them on the field for several days. Again, rude megalithic structures must have been built chiefly by main force, and I doubt if any extant savages could lift these stones. The strength of a lion is not in his bones, but in his muscles. Primitive man may have been muscled like a lion. David says he tackled lions and bears when a shepherd, unarmed. It is hardly probable that the historian would have put in a trait which his epoch would have set down at once as mere bounce. How can any one write, as in the article in question, "He had neither the swiftness of the weaker kinds to escape" [how about Deerfoot?] "nor of the stronger to pursue, and he was without the natural weapons with which other animals were provided." I really do think that, if one read these words to an average gorilla, he would conceive some doubts as to whether the "missing link" had, after all, developed so very much. What are *his* weapons?

If we go back far enough, we must arrive at a man, or men, without any sort of weapon. How did they survive long enough to beget those who *did* discover weapons? Not, surely, by conjugating *τύπτω*—which seems to be your writer's thesis.

I humbly submit that nothing can impede *knowledge* so much as laying down for facts what are not worthy even to be theories.

HALLYARDS.

OUR TWO BRAINS.

[1590]—I should like to make a few observations on "C.'s" article [1579]. He considers that he was unconscious for seventy or eighty minutes, during which he was playing, with due regard, not only to the rules of play, but also to the changes and chances of the game in which he was actually engaged—acting, in fact, exactly as a fully conscious person would act. And he considers that he recovered consciousness when he lost all memory of what he had been doing.

It seems to me that this is not a correct view of the matter, and that "C." never really lost consciousness of what passed during those seventy or eighty minutes till the time when he himself thinks he recovered it.

G. O. E.

MATTER.

[1591]—I shall feel obliged if you will again kindly allow me space for a reply to "F. W. H."

For the sake of clearness, I have all along striven to consider the questions (1) the unalterable nature of atoms, and (2) the conceivability of their being conscious of their own motion, quite separately; but, unfortunately, "F. W. H." still continues to intermingle the two. Of course, if "F. W. H." chooses to think of atoms as unalterable in their nature, I have no wish, and have no right, to attempt to force him to think otherwise; he, like everybody else, is entitled to his own thoughts. But I have a most decided objection to any one's saying, as Haeckel does, that "we *must* hold that atoms have an unalterable nature," &c. (the italicizing is mine), merely because it seems so to him. I repeat my original assertion—that, it is impossible to obtain such universal and exact knowledge. A little consideration of the limits of human inquiry must surely lead "F. W. H." to see that this is so.

I would not hesitate to apply Clifford's test to Du Bois Reymond's statement about the inconceivability of atoms being conscious of their own motion; but the difference between the two cases is that, whilst Haeckel's statement about the unalterable nature of atoms relates to something quite outside the sphere of human knowledge (and, therefore, concerns something which, as Clifford says, we cannot know without ceasing to be men), Du Bois Reymond's assertion relates to something which we can know, viz., the conceivability of atoms possessing a consciousness of motion. Thus whilst Clifford's test is in the first case at once applicable and destructive, it in the second has no point of contact.

Here I would point out an error into which "F. W. H." falls through his intermingling the two questions. He says that "Reymond dogmatically predicates on the past, present, and future nature of atoms, assuming the position of the prophetic seer," &c.; and evidently takes pleasure in showing that Haeckel is less ambitious, since he confines himself to speaking of the properties of atoms "at present." If "F. W. H." will read the quotation over again he will see that Du Bois Reymond predicates nothing whatever about the past, present, or future *nature* of atoms, but simply asserts that their unconsciousness extends to *motion* past, present, or future. This is something very different from a predication about their past, present, or future nature.

I entirely fail to see how this is "slamming the door in the face of all inquiry after truth;" rather does it seem to me a philosophical recognition of the truth that we are incapable of conceiving atoms to possess a consciousness of motion. Professor Tyndall, than whom there is no more earnest searcher after truth, and who certainly cannot be accused of "slamming the door" in her face, supports Reymond's view. In his famous "Belfast Address," he says, "You cannot satisfy the human understanding in its demand for logical continuity between molecular processes and the phenomena of consciousness;" and in his essay on "Scientific Mate-

XUM

rialism," he speaks still more strongly: "The passage from the physics of the brain to the corresponding facts of consciousness is unthinkable. Were our minds and senses so expanded, strengthened, and illuminated as to enable us to see and feel the very molecules of the brain; were we capable of following all their motions, all their groupings, all their electric discharges, if such there be; and were we intimately acquainted with the corresponding states of thought and feeling, we should be as far as ever from the solution of the problem, 'How are these physical processes connected with the facts of consciousness?'"

I am still quite unable to discover that I have a consciousness of "unconsciously" liking things. The verb "like" implies consciousness. If I say that I like mutton, I mean that this particular kind of meat produces a certain definite, molecular arrangement in my brain, which is the physical fact somehow connected with the pleasant sensation of which I am conscious.

J. T. Routledge.

FRICTION.

[1592]—I am surprised to notice Mr. Browning, in his article, "How to Take Care of a Tricycle," in No. 170, state that "*friction increases with velocity, but not with pressure*, unless the pressure is so great that the lubricant is squeezed out." It is only necessary to look up any authority on mechanics to find that "the resistance due to friction is equal to the direct pressure between the surfaces multiplied by the co-efficient of friction, this co-efficient depending on the nature of the surfaces and the lubricant adopted. Of course, the latter part of Mr. Browning's statement quoted above is correct in so far that friction greatly increases when the pressure is so great as to force out the lubricant. J. Y.

LETTERS RECEIVED AND SHORT ANSWERS.

S. L. B. points out that (according to the text) the words "Perihelion" and "Aphelion" are transposed in the diagram on p. 89.—Nemo. I am sorry to find you wasting your time over such trash as the printed letter you enclose. The person who wrote the paragraph concerning the satellites of Uranus was hopelessly ignorant of astronomy. The motion of the satellites of Uranus, as referred to those of every other satellite in the solar system, *is* retrograde—unless you choose to say that the plane of their orbits has not only been rendered perpendicular to the ecliptic, but has been tipped 10° over towards the other side! I suspect that the (so-called) "medium" got her knowledge of the two satellites of Mars from "Gulliver's Travels," whence we learn that they were discovered by the astronomers of Laputa (see paragraph nine of Chapter III. of the "Voyage to Laputa," in "Gulliver's Travels;" and remember that this was written in 1727). Pray read paragraph in capital letters which concludes the heading of the Correspondence column.—Wm. Douglas. Simpkin, Marshall, & Co., London, publish the book you want.—A. J. W. The discs which your telescope gives to stars are merely spurious or optical ones, the star being in reality a *point* of light of absolutely insensible dimensions as viewed from the earth. Your notion, then, that its circular figure (which is the product of your object-glass, and of that alone) would undergo change were an opaque body gradually to intervene, is perfectly baseless. Oh, yes, the interposition of rings of planetoids, meteorites, or nebulous matter has been suggested as a cause of stellar variability. In the case of stars of the Algol type, their periodical partial eclipse by a huge dark satellite seems to afford the most feasible explanation of their variation.—E. A. Tindall. Your football experience so strongly resembles that of C. (letter 1579, p. 114) as to be scarcely worthy of reproduction. Forgive me for saying that every one who writes to this paper is entitled to have his communication acknowledged; and to leave people without replies simply because they make foolish or unjustifiable requests would be to invite a repetition of letters which they would then believe I had never received. I have excluded, and shall continue to exclude, all theology, properly so called. Certainly Dr. Lewins's letter in no sense trenched upon this ground, although "An Earnest Thinker's," I fear rather did. However, the last-named correspondent will have to modify his style of argument (?) if he again seeks admission into these columns. The papers on "Light-sifting" will appear when others now in hand are disposed of. It occurs to me (rightly or wrongly) that you must be a very young man, if I may judge from the calm affectation of infallibility with which you are so good as to try to teach me my editorial duties.—Patrick O'Brien relates how he dreamed that a favourite cat was sitting at the foot of his bed, and, after awakening, distinctly saw the dream-image of the cat for several seconds. This persistence of objects seen in dreams on rousing is not a very infrequent phenomenon. Thanks for your P.S.—London and Westminster Supply Association. Received,—J. M. A moment's reflection will show you that your letter amounts to a mere advertisement of a particular tradesman. This can only appear in the proper columns.—A. If a man did not habitually dress for dinner every night, I can quite understand how the taking off his clothes would suggest the act of winding-up his watch. It is only when we reflect a little that we realise how many of our actions are automatic.—F. Gartside-Tippinge. Such communications should be directed to Richard Hodgson, Esq., St. John's College, Cambridge. The Society's address is 14, Dean's-yard, Westminster, London, S.W.—Night Student asks for the simplest and cheapest form of artificial light for painting by. Pending replies from experts, I should say that a Duplex lamp, with a neutral-tint chimney, would be as efficient as anything.—W. R. Bland writes that Messrs. Newtons and Messrs. Negretti & Zambra, London opticians, sell the anorthoscope. Prices not given, as this is not the part of the paper in which advertisements appear.—R. Elmore. Pre-occupied as I am, it is simply impossible for me to make engagements to personally view pictures, apparatus, exhibitions—or, in fact, anything else.—F. W. Rudler. Received with thanks.—Boyd Moss. Do you not see that you are simply asking me to advertise a particular tradesman gratis?—Leonard Orrell Hey. A superstition, and an utterly baseless one, of which it is difficult to trace the origin.—J. Newman asks Mr. Mattieu Williams how to prevent the formation of "mother" in cider that is being made into vinegar.—John Gorham. Subject to limitations of space, I shall be pleased to insert your paper.—Caroline A. Martineau. Many thanks for the trouble you have taken, but you will perceive that I have had to condense your condensation very materially indeed. It would be impossible to give anything approaching to verbatim reports of popular lectures on subjects already so fully treated of as that is in the works of Darwin, Lubbock, &c.—G. H. Wilkinson suggests that Mr. Alexander (letter 1575, p. 95) cannot have been "unconscious" if he talked "reasonably;" and, further, that temporary concussion and chronic disease of the brain affect it differently. Double vision in drunkenness has its origin in the abnormal condition of the circulation in the brain, which renders it impossible for the subject to co-ordinate the movements of the muscles of his two eyes. For single vision the object must be presented to both eyes under precisely similar conditions.—R. Ababrelton. Received. According to your idea, the critic must have misinterpreted the internal evidence. The conductor of this magazine signs every line he writes in its columns.—Threepence. I could easily give you another couple of pages, were I to print more of the letters which reach me; but, as it is, can you give me the name of a single scientific journal in which you obtain the same amount of *original* matter for your money?—Wm. Swanston. Received.—Captain D. Forbes. Thanks; but the alterations are merely of professional interest, and are not sufficiently great to justify the occupancy of space with them.—G. D. D. Your use of the word "equilibrium" is not legitimate.—The force of gravity is acting on the body from the very instant that it leaves the hand; and continues to act against the projectile force until it nullifies and overcomes it.—Zoilus. The language is neither mine nor that of any contributor to these columns. In reproducing articles of interest, as is occasionally done, they are, and only can be, reprinted *verbatim*.—Geometres. I regret that I have no room at my disposal for papers on elementary arithmetical and geometrical teaching. Knowledge was not established as an organ of primary elementary education. Your supposed solution of the problem of the trisection of an angle by Euclidean geometry is returned to you by post, as at once unsound and unsuitable. Kindly note that I neither can nor will enter into any discussion whatever with you on the subject.—H. B. L. "A hundred suns" was merely "façon de parler." I question if any one has *counted* more stars in this group than Wolf.—Ada S. Ballin. Received, with thanks.—W. Oldham Chambers. Thanks, will be utilised.—John Ross. Forwarded to the conductor.—Captain D. M. Forsyth, R.N. "Elementary Astronomy," published by Cassell & Co., is, I think, the book you mean. Kindly read the paragraph in capital letters which concludes the heading of the correspondence columns.—Dr. Prevost. I have for a long time had a manuscript article lying here. If you wish it returned, kindly send a stamped and directed envelope for that purpose.—W. R. K. calls attention to a truly extraordinary mistake in the engraving of the Star Map on p. 65, where south-west, west, and north-west are printed for south-east, east, and north-east, and *vice versâ*.—John Harris. Received.—Clark Bell. Received.

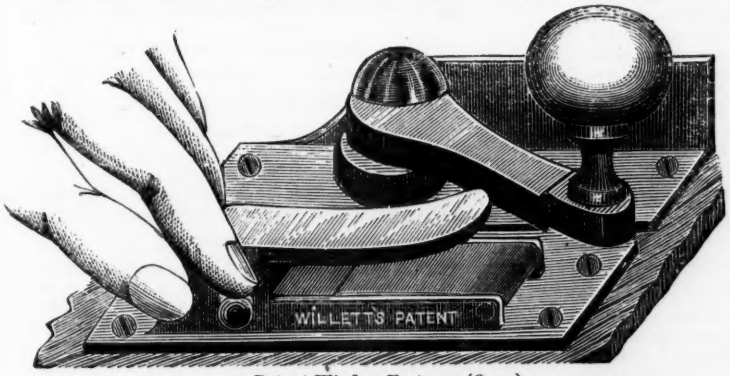
The circus-ring at the Covent Garden Theatre has been entirely covered by what is probably the largest mat yet made. It is over two tons in weight, and is made of unbleached cocoa-nut fibre, has a soft pile 4 in. thick, and makes a good substitute for turf.

Our Inventors' Column.

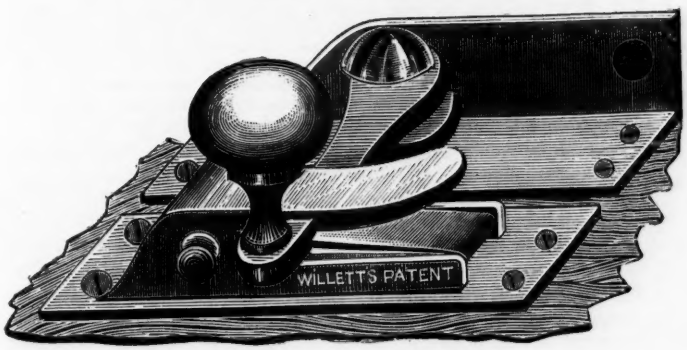
We give here, week by week, a terse description of such of the many inventions as we think may be of use to our readers. Where it is possible, the number of the patent is quoted, to enable those who desire fuller information to procure the specification from the Patent Office in Cursitor-street, Chancery-lane. We shall, generally speaking, confine ourselves to the more recent inventions; but it often happens that an article comes under our notice which, although not quite novel, is worthy of mention for its utility and ingenuity. In such a case we should not hesitate to refer our readers to it. And while we thus increase the interest of our pages, we at the same time assist the inventors by giving greater publicity to their inventions (KNOWLEDGE *being a popular magazine*) *than is accorded by the most excellent trade journals.*

WINDOW FASTENER.

[Patented, 1884.] The subject of this patent, taken out by Mr. S. Willett, of Herne Hill, is a sash-fastener which shall be burglar-proof. The two Figs. illustrate the closed and open



Patent Window Fastener (Open).



Patent Window Fastener (Closed).

portions respectively. The handle, on being turned, presses down and passes over a flat spring, and when it reaches the end of its movement, the spring being passed, rises up and presses against the handle, thereby preventing it being opened in the ordinary way. To release the handle a small knob is depressed, as shown in the upper figure, the spring is lowered, and the handle may be turned to the open position. This ingenious device precludes the possibility of the handle being turned by inserting a knife blade between the sashes, a proceeding which is also hindered by the fact that the square part of the handle acts as a lug, which, when in the closed position, squeezes the two sashes together.

FIRE EXTINGUISHER.

THE losses of property by fire in this country are immense, but might be very materially diminished by the introduction and general adoption of a simple device for arresting the progress of fires in their incipient stages.

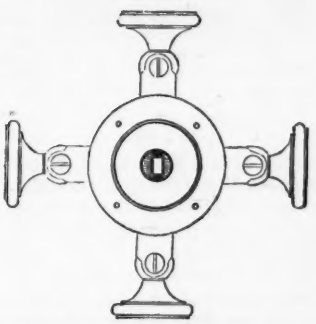
Large sums are annually spent by property owners in fire escapes, stand-pipes, sprinklers, and hose attachments in buildings, but these too often fail to be of practical value at the incipient stages of the fire. Again, there has often been more damage occasioned by flooding with water than by the fire itself.

Amongst the numerous inventions and devices which have been brought to public view during the past few years, the Harden Hand-Grenade Fire-Extinguisher stands pre-eminent as something that is simple, efficient, always ready, that will not get out of repair, and at the same time can be effectively used by any one who happens to be near when the fire breaks out.

The Grenade consists of a glass globe, hermetically sealed, filled with a chemical fluid which does not deteriorate with age, is not affected by any climate, will resist a temperature of 20° below zero, and is perfectly harmless to flesh or fabric.

The contents of these Grenades, when thrown upon or into fire, vapourise immediately into immense volumes of a fire-extinguishing gas (carbonic anhydride), in the presence of which combustion cannot possibly exist. They are small and convenient for handling, can be hung up in any place, and are accessible at an instant's notice. They prevent damage from water. They operate instantaneously, and are cheap. They are guaranteed to be perfectly uniform in quality and efficiency, and every one of them is subjected to a thorough chemical test to assure absolute certainty as to its quality.

Fire-Extinguishing Grenade.



Occulting Eye-piece.

A NEW OCCULTING EYE-PIECE FOR ASTRONOMICAL TELESCOPE.

MR. R. G. MASON, practical optician, of 24, Park-road, Clapham, S.W., has recently introduced this valuable instrument under the direction of Dr. Edmund J. Spitta, whose device it is. It consists essentially of a shallow cylinder of brass, containing four shutters placed over the arrangement of lenses. By an ingenious contrivance, which is fully explained at page 92, R.A. Society's Monthly Notices, No. 2, December, 1884, the "knife-edged" occulting end of each shutter always remains in focus. The regulating screws may thus bring any or all of the shutters singly or simultaneously into effective use, without any inconvenience to the observer; they are "easily under his command, and not weighty enough to require a counterpoise."

The figure herewith, shows the instrument viewed from above, with lenses and cap removed to exhibit the occulting shutters. Such an arrangement cannot fail to be of great value to every observer of the heavenly bodies, and we may fairly congratulate Mr. Mason upon the skill he has displayed in perfecting the practical details of this useful contrivance.

Our Chess Column.

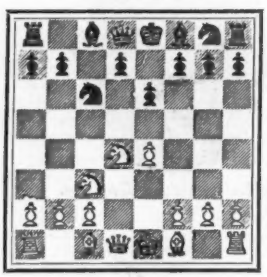
By Mephisto.

THE SICILIAN DEFENCE.

THE consensus of opinion of players having the requisite analytical knowledge is that, as a defence, the Sicilian suffers in comparison with the French. In most variations of the Sicilian the second player will incur a slight inferiority of position, whereas in most variations of the French Defence, the second player will be able to equalise matters. The only variation in the French Defence in regard to which we as yet do not feel justified in denying the verdict to the first player, is White's continuation of 2. P to K5, although we are opposed to this move, whereas the only variation in the Sicilian defence which seems to give the second player some hope of holding his own, is Black's continuation of 5. Kt to B3. A general rule in this opening is to play both White Knights to B3 and then play P to Q4, also B to QR3 when such is possible, in consequence of the exchange of Black's KB for the White QKt. Endeavour should also be directed to prevent Black from playing P to Q4, in which case the square on Q6 offers a strong position for a White Kt or B. Failing in all this points, White, with sufficient care and attention, should be able to gain other small advantages, such as a good centre position, a good position for his pieces, &c. 1. P to K4, P to QB4. 2. QKt to B3, QKt to B3. 3. Kt to B3, P to K3. 4. P to Q4, P × P. 5. Kt × P.

In this, the normal position, Black has the following moves at his disposal, viz :—

Black.



White.

5. Kt to B3,
5. B to Kt5, and
5. P to QR3.

Of these, the first is the best, and may be met as follows :—

5.	Kt to B3
6. B to K2	

There seems to be more solidity in this move than in the continuation of 6. Kt × Kt, KtP × Kt, as, in order to prevent Black from playing P to Q4, it seems necessary to play 7. P to K5, Kt to Q4. 8. Kt to K4, &c., with perhaps equal advantage, but we are (perhaps prejudicially) disinclined to favour the advance of P to K5 early in the game.

6.	P to Q4
7. P × P	Kt × P
8. Kt × Kt	Q × Kt

Now for the End Game. White can obtain an advantage by either 9. B to B3 or by 9. Kt to Kt5. If again

5.	B to Kt5
6. Kt × Kt	KtP × Kt
7. Q to Q4	B × Kt (ch)
8. P × B	

with the better position, as B to R3 will be very powerful. Finally, if 5. P to QR3, Black has simply lost time, and White may proceed to develop by B to K2. P to QR3 was formerly played to prevent KKt to Kt5, which sometimes will become dangerous in this opening. But in reply to either 5. B to Kt5 or Kt to B3, White's attack of 6. Kt to Kt5 does not lead to much, as the following interesting variation—which has an American origin—will show :—

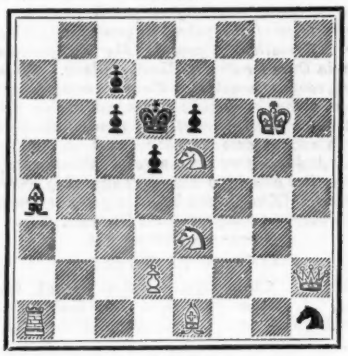
5.	Kt to B3
6. KKt to Kt5	B to Kt5
7. Kt to Q6 (ch)	K to K2 !
8. QB to KB4	P to K4
9. Kt to B5 (ch)	K to B sq.
10. QB to KKt5	P to Q4 !
11. P × P	Q × P

with a promising position. With regard to Black's move of 5. P to KKt3, we do not think that White need do anything better than develop by 6. B to K3, threatening, if B to Kt2, 7. KKt to Kt5, or if P to QR3, 8. Kt × Kt, and probably 9. B to Q4, &c. In any case White will obtain a speedy development and a commanding position for his pieces, which advantage should enable him to combat successfully the antiquated mode of advancing Pawns against pieces—worst of all K or QKtP—embodied in the Silician Defence.

PROBLEM No. 147.

By O. H. Labone.

Black.



White.

White to play and mate in three moves.

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

C. Planck.—Thanks, but already corrected last Saturday.

Edw. Carter.—Problem received with thanks.

Enquirer.—Address of the "Chess-players Chronicle," 17, Medina-road, N; address of the "Chess Monthly," 18, Tavistock-street, W.C.

Settlement in Masonry.—Next to the Washington Monument, the highest structure in the United States is the tower of the new public building at Philadelphia. It is reported that the outside has become cracked, and that the cause has been ascribed to the contraction of the brick masonry at the back of the marble facing. The mean pressure at the section showing this distress is estimated at 9 tons per square foot. The base of the tower of the capital at Hartford, Conn., shivered a few years ago because the builders, in their desire to make good joints in stone masonry, laid them with contact at the edges. The difficulty was repaired by pouring a number of tons of melted type-metal at the back of this masonry; the alloy, expanding as it cooled, transferred the pressure from the front edges towards the middle of the tower foundation; the surface blocks were dressed over again, and in some instances new stones were laid in.—*Engineering.*

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NOTICES.

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